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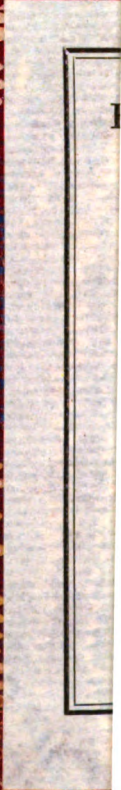


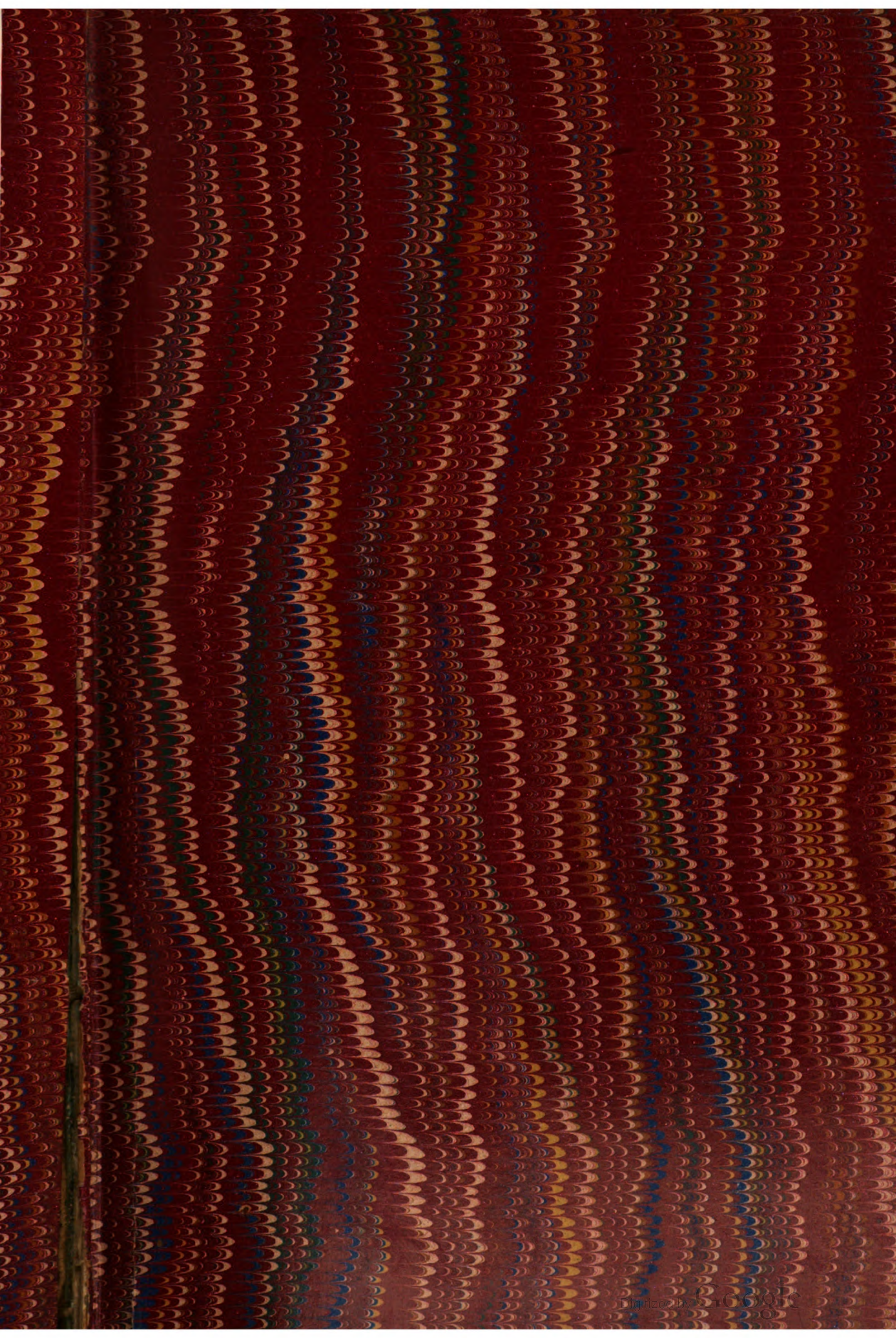
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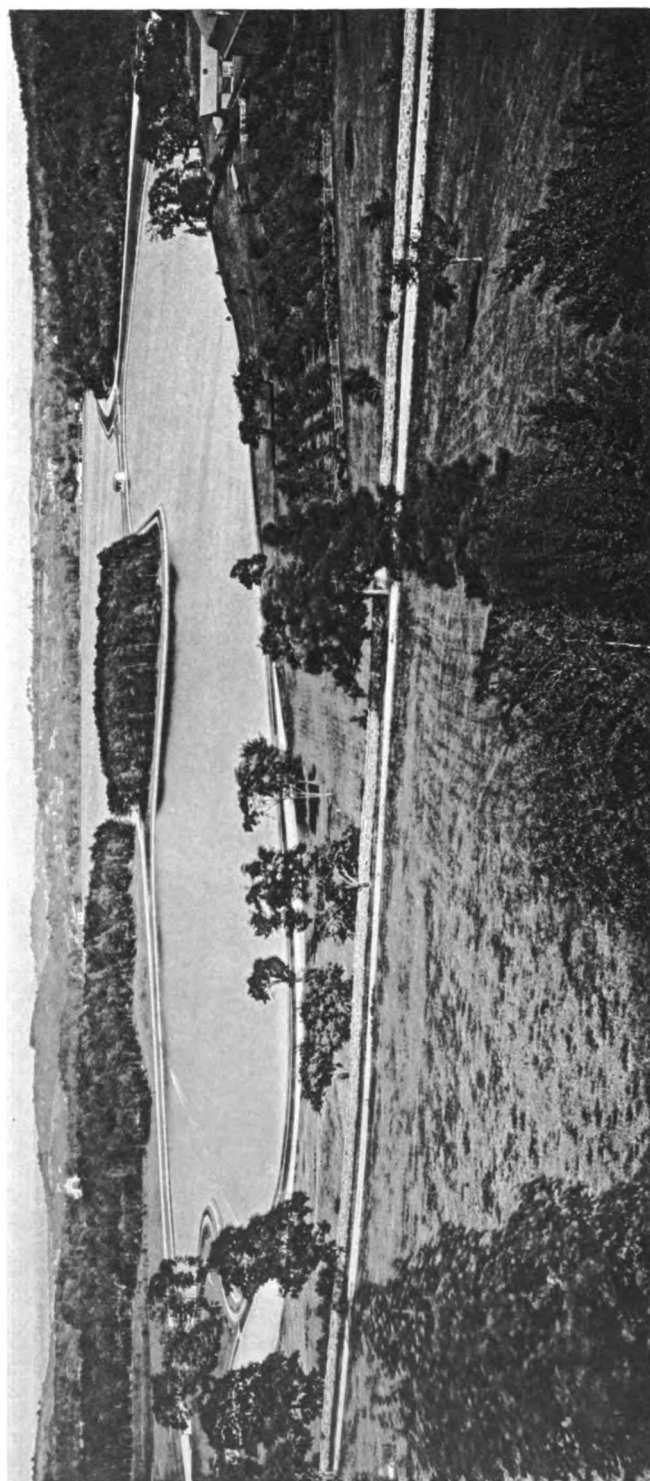
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View of Chesapeake Bay from the Lawrence Point Lighthouse

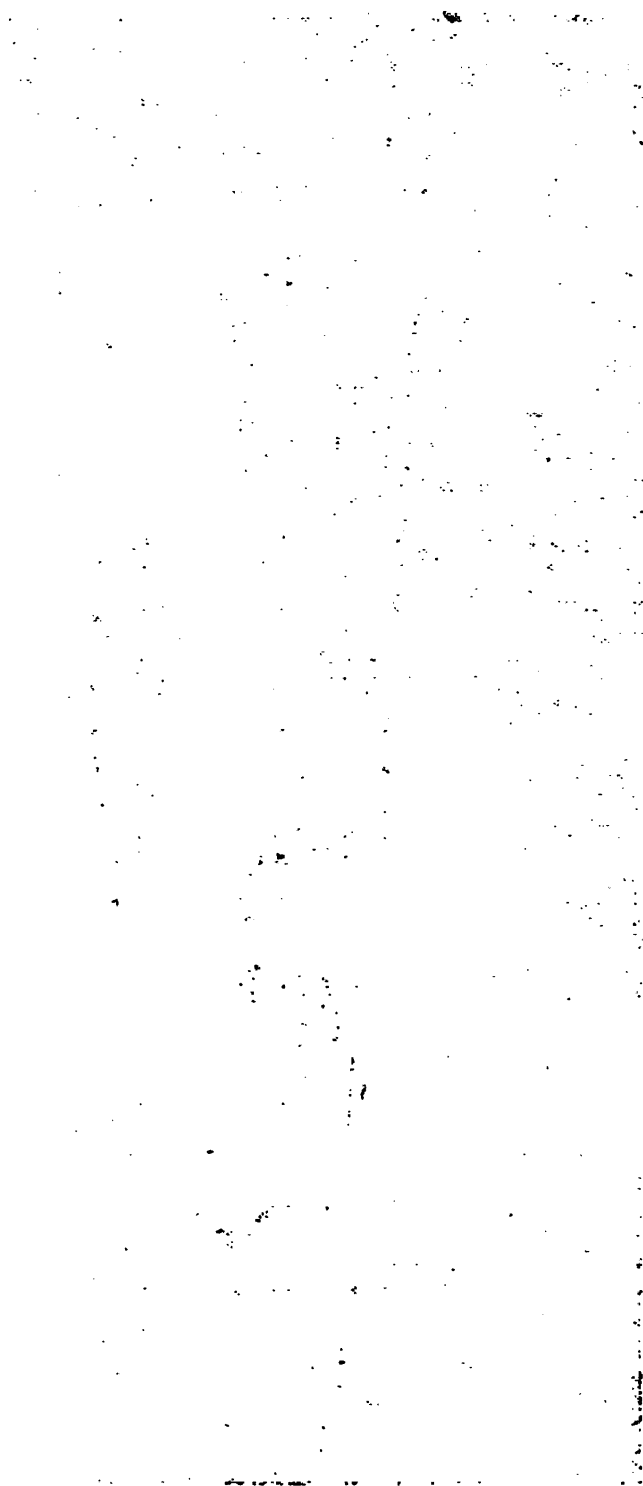
HISTORY

BOSTON WATER WORKS.

1866 TO 1876.

REPORT OF THE COMMISSIONERS OF THE BOSTON WATER WORKS,
FOR THE YEAR 1876.

Boston:
PUBLISHED BY THE BOSTON WATER WORKS,
1876.
C.
G. & Z.



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HISTORY

OF THE

BOSTON WATER WORKS,

FROM

1868 TO 1876.

BEING A SUPPLEMENT TO A "HISTORY OF THE INTRODUCTION OF PURE
WATER INTO THE CITY OF BOSTON, WITH A DESCRIPTION OF
ITS COCHITUATE WATER WORKS, ETC., 1868."

Boston:
ROCKWELL AND CHURCHILL, CITY PRINTERS,
No. 39 ARCH STREET.

1876.

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PREFACE.

The following compilation of official documents relating to the Boston Water Works, from 1868 to 1876, is intended as a supplement to Mr. Nathaniel J. Bradlee's valuable history, referred to on the title-page.

Since the date of that work many important changes have been made in the water system, the principal of which have been the addition of the high-service and extensive enlargements of the distributing system, as applied to the Cochituate Works, and the adoption by the city government of an entirely new source of supply to meet the daily increasing demands of the city. These subjects, with the records of the Water Board and City Council, together with some statistical matter, comprise all that is attempted in the limits of this supplement.

It has been the aim of the compiler to avoid adding to the official record any words beyond what were necessary to form a connected meaning. Nearly all of the contents, whether indicated by quotation marks or not, have been taken from various documents and records; — the fact that these sources of information are somewhat scattered forming the incentive to the undertaking.

It will be noticed that the plan has been adopted of separating the historical from the descriptive portions of the several parts, which it is believed will facilitate reference.

Since going to press the Cochituate Water Board has ceased to exist. On July 6th, 1876, the Mayor, in accordance with the authority

of the "Ordinance to establish the Boston Water Board," appointed Timothy T. Sawyer, Leonard R. Cutter, and Albert Stanwood, members of said Board. These nominations were confirmed by the City Council on July 24th, and on July 31st the last meeting of the old Board was held, and the property of the Water Works turned over to the new Board, who on that day entered upon their duties.

This supplement, therefore, practically completes the record of the Cochituate Water Board, and closes an historical period in the existence of the Water Works.

DESMOND FITZGERALD,
Supt. Western Division.

OFFICE OF THE BOSTON WATER BOARD,
August 4th, 1876.

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PART FIRST.

PROCEEDINGS OF THE CITY GOVERNMENT AND THE
COCHITUATE WATER BOARD OF A GENERAL
NATURE, 1868—1876.

1868.

WATER FOR ROXBURY.

On January 6th, 1868, the annexation of Roxbury to Boston was consummated, and the extension of water-pipes to that district rendered necessary.

January 7th, the City Engineer was requested to furnish plans and levels for this purpose; and on the 23d circulars were left at the doors of the inhabitants, asking certain questions, the principal of which was, "Do you wish to take the Cochituate water, as soon as the main pipe is laid?"

On the 24th of March the following answers were received:—

Returns made	2,602
Not returned	1,398
Want the Cochituate	1,001*
May want it	390
Do not want it	1,211
Supplied by Jamaica pond	740
“ “ wells	1,230
“ “ cisterns	697

The subject of building a reservoir in the Roxbury District was agitated, and early in January the City Council passed an order directing the Water Board to report the cost of the same; but as the new territory was so much nearer the centre of distribution than the other city reservoirs, the Water Board reported that it would not be necessary.

A question arising as to the exclusive right of the Jamaica Pond Aqueduct Co. to lay pipes in Roxbury, the City Solicitor gave it as his opinion, March 24th, that the "Jamaica Pond Aqueduct Co. has no exclusive right to supply water" to Roxbury, and "that the city has full right to lay pipes and furnish the Cochituate water to all persons within the limits of that territory, who choose to take it."

* In 1870, there were 1,419 takers in Roxbury.

An appropriation having been made by the City Council early in April, for the laying of pipes in Wards 13, 14 and 15 (Roxbury), a contract for them was at once made by the Water Board.

The actual laying of pipes was begun the second week in April, with old pipes already on hand.

Hereafter, whenever the term, "the Board," is used, the Cochituate Water Board is meant.

Mr. Nathaniel J. Bradlee having completed his "History of the Introduction of Pure Water into the City of Boston," to which reference is made in the Introduction, and frequently throughout this work, the Water Board, on January 28th, passed the following vote:—

Voted, That the thanks of the Board be tendered to their respected associate, Nathaniel J. Bradlee, Esq., for his faithful, clear and interesting history of the great enterprise of introducing pure water into our city, with a description of the works.

JOHN H. THORNDIKE, *President*.

The same day, an elaborate opinion was received from Clement Hugh Hill, in which the City Solicitor concurred, giving an opinion in favor of the legality of placing water meters in model lodging-houses.

February 6th. Mr. William F. Davis was re-elected Water Registrar by the City Council.

REPAIRS OF EAST BOSTON RESERVOIR.

The East Boston reservoir having been in a leaky condition for some time, measures were taken to repair it.

February 18th, the City Engineer's plan for removing the stone lining and the adjacent soil, and introducing a layer of clay 18 inches in thickness, under the stone work, was approved.

The leakage from this reservoir amounted to as much as 19,000 gallons per day with 15 feet of water, and 50,000 gallons with 20 feet of water. The leakage was not confined to the banks, but was principally through veins of sand and gravel in the natural soil.

April 4th. The water was drawn off and the work commenced.

The repairs continued until December 24th, when they were sufficiently advanced to allow the introduction of 20 feet of water. The following spring (1869) work was recommenced and completed August 1st, when the basin was allowed to fill. There have been no signs of leakage since. (See City Document No. 51, 1870.)

DUG POND.

March 30th. The President reported that he had purchased, in addition to lands already held, the following pieces around Dug pond, in Natick :—

	A.	R.	Rds.
Inhabitants of Natick	3	0	9
Aaron Fiske	7	0	0
Moses Fiske	0	0	23
M. W. Hayward	1	0	24
John A. Whitney	2	0	23
John J. Williams	2 ³ / ₁₀	0	0
George M. Stratton	16	3	0
In addition to the above, on April 3d, Timothy Coolidge	1	1	33

April 6th, a meeting of the Board was held for organization, the following gentlemen having been elected by the City Council on February 13th :—

Alderman, . . .	BENJAMIN JAMES.
Common Council, .	BENJAMIN F. STEVENS,
“ “	CHARLES R. TRAIN.
At large, for two years,	JOSEPH M. WIGHTMAN,
“ “	GEORGE LEWIS.

The terms of Nathaniel J. Bradlee and Alexander Wadsworth unexpired.

The following officers were elected :—

President, . . .	NATHANIEL J. BRADLEE.
Supt. West. Division,	ALBERT STANWOOD.
Supt. East. Division,	EZEKIEL R. JONES.
Clerk, . . .	SAMUEL N. DYER.
Clerk of Committees,	WILLIAM C. PHELAN.

The following Standing Committees were appointed by the President :—

Western Division.—Messrs.	WADSWORTH, LEWIS, and JAMES.
Eastern Division.— “	LEWIS, WIGHTMAN, and TRAIN.
Water Reg.'s Dep't.— “	WIGHTMAN, TRAIN, and STEVENS.

And the following Special Committees :—

Construction of Chestnut Hill Reservoir.—The PRESIDENT, and Messrs. WADSWORTH and LEWIS.
Purchasing Land.—The PRESIDENT, and Messrs STEVENS and WADSWORTH.
Auditing Committee.—Messrs. STEVENS, JAMES, and WIGHTMAN.

A special report was made by the Board to the City Council (see City Document No. 44), reviewing the condition of the Water Works, asking for a change of fiscal year; and that the election of Water Registrar be made by the Board.

It will be stated here, for the benefit of those who do not possess a copy of Mr. Bradlee's History, that the Cochituate Water Board is composed of seven members, as follows: one Alderman, two Councilmen, and four members at large. Two of the latter are elected every year, for a two years' term, and all serve without pay.

In May the Board made their Annual Report.*

The main points to which attention is called, are:—

The laying of pipes in Roxbury.

The repairs of East Boston reservoir.

The rebuilding of the filter dam at Pegan brook.

The procurement of releases from encroachments on the line of the aqueduct, and around the lake.

The purchase of the lands around Dug pond.

The progress of work on Chestnut Hill reservoir.

The raising of the last section of the mains on Tremont street.†

The housing over of the city of Chelsea's and the city of Boston's water pipes, on the same capping.

(See City Document No. 78, 1868.)

October 26th. Water was let into the pipes of the Highland or Roxbury District. The same day water was let into the Lawrence basin of the Chestnut Hill reservoir. (See Part Third, History of Chestnut Hill reservoir.)

The High Service works were under consideration at this time. (See Part Third, History of the High Service.)

December 16th. The President was authorized to sign a contract for water-pipes, at a price not exceeding \$71 per gross ton.

1869.

February 11th. Mr. William F. Davis re-elected Water Registrar by the City Council.

February 15th. A severe freshet washed a portion of the banks of the Conduit at Newton.

* The annual reports of the Board are made on the first of May in each year, and cover the preceding twelve months, or official year.

† The cost of raising the mains on Tremont street, between Waltham and Dover streets, was \$6,158.18.

In February the City Council elected the following members of the Board : —

Alderman, . . .	BENJAMIN JAMES.
Common Council, .	ALEXANDER WADSWORTH,
“ “	FRANCIS A. OSBORN.
At large, for two years,	NATHANIEL J. BRADLEE.
“ “	CHARLES H. ALLEN.

The terms of Messrs. George Lewis and Joseph M. Wightman, unexpired.

On April 5th, a meeting was held for organization, and the following officers were elected : —

President, . . .	NATHANIEL J. BRADLEE.
Clerk, . . .	SAMUEL N. DYER.
Clerk of Committees,	WILLIAM C. PHELAN.
Supt. Western Division,	ALBERT STANWOOD.
Supt. Eastern Division,	EZEKIEL R. JONES.

The President and Mr. Wightman were made a committee on rules and regulations.

The President appointed the following Standing Committees : —

Water Reg.'s Dep't. — Messrs.	WIGHTMAN, JAMES, and ALLEN.
Eastern Division, “	LEWIS, WIGHTMAN, and OSBORN.
Western “ “	WADSWORTH, ALLEN, and JAMES.
Construction of Chestnut Hill Reservoir. — The	PRESIDENT and Messrs.
WADSWORTH and LEWIS.	

Special Committees : —

High Service. — The	PRESIDENT and Messrs. LEWIS and WIGHTMAN.
East Boston Reservoir. — Messrs.	WIGHTMAN and OSBORN.
Construction of Telegraph. — Messrs.	WIGHTMAN, JAMES, and ALLEN.

March 26th. An order of the City Council was approved requesting the Mayor to petition for an act to lay pipes to Deer Island.

The Board, in their annual report, call attention to the following facts connected with the history of the past year : —

Number of feet of main pipes laid during the year, 53,567.

Number of service pipes laid during the year, 1,342.

Plans adopted for a high-service system.

Setting of boundary stones at the lake and on aqueduct.

Progress of work on Chestnut Hill reservoir.

The Rules and Regulations of the Board will be found annexed to the Report.*

At the request of the Water Board, the City Council passed an order (approved May 26), authorizing the Auditor to place to the credit of the Water Works certain sums received by the Sewer Department. This action was in consequence of an arrangement between the Sewer and Water Departments, by which the excavations, in one or two instances, for short distances, through rock cuts, were made wide enough and deep enough for the sewers; but the water-pipes in no cases lie in the same trenches with any other public or private works. In the cases referred to, the pipes were at one side of the sewers, and above them, so that in case of repairs there is no interference between the two.

CONTRACT WITH CHARLESTOWN.

On May 20th the Board sent a communication to the City Council advising that negotiations be made with the city of Charlestown, for the supply of East Boston from Mystic lake. They say: "We consider it important to have arrangements made at an early day, as Charlestown has already agreed with the city of Chelsea and the town of Somerville, and should any other be added, it would not be prudent for them to undertake to supply any portion of our city. It must also be borne in mind, that if an agreement can now be made it will postpone for a much longer time the necessity of another source of supply."

This communication resulted in the passage of the following order by the City Council, approved June 28th:—

"*Ordered*, That the Cochituate Water Board be, and they are hereby authorized to contract with the Mystic Water Board of the city of Charlestown, for supplying Ward 1 (East Boston) with water from Mystic pond, upon such terms and conditions as the said Cochituate Water Board may deem expedient, subject to the approval of his Honor the Mayor."

On July 1st the Board of Directors for Public Institutions petitioned the City Council for the extension of the water-pipes to Deer Island (see City Document No. 85), which resulted in an order, approved September 24th, authorizing the Water Board to convey water to Deer Island. In the mean while, July 12th, the city of Charlestown had given its Board the requisite authority to make a contract with Boston, and on October 1st a contract was consummated for the supply of East Boston and Deer Island with Mystic water.

* Amended in 1872. See Part Fourth.

Contract. — City of Charlestown and City of Boston, for a supply of Mystic Lake Water, 1869.

This agreement, made this first day of October, eighteen hundred and sixty-nine, between the City of Charlestown in the county of Middlesex, by the Mystic Water Board, duly authorized, of the first part, and the City of Boston in the county of Suffolk, by the Cochituate Water Board, duly authorized, of the second part, Witnesseth : That the said party of the first part, in consideration of the water rents hereinafter to be paid, hereby agrees to and with the said party of the second part, that the said party of the first part will furnish all the water needed by the inhabitants of Ward One (East Boston), and the public institutions at Deer Island, during the continuance of this agreement as hereinafter provided, and that the supply of the same shall not be restricted unless the source should prove inadequate to exceed the requirements of the Cities of Charlestown and Chelsea, and the Town of Somerville.

And the said party of the second part hereby agrees to lay and maintain all the pipes, stop-gates, hydrants, meters, and everything connected with the distribution and use of the water, from the point of connection with the pipes of the Charlestown Water Works, in City Square, Charlestown, free from any expense to the said party of the first part.

And the said party of the second part further agrees to and with the said party of the first part, that for all the Mystic lake water furnished and used by the people of Ward One (East Boston), and for water used by the public institutions at Deer Island, and for fire hydrants, there shall be paid water rents at the same rates and prices as are charged at the time when this agreement shall go into effect, or may be charged during the time of this agreement by the said party of the second part to the inhabitants of the City of Boston under the same rules and regulations that are or may be established for like use of water in other portions of that city, provided that the rates shall in no case be less than the average of those existing on the first day of January, A. D. 1870, except with the assent of the Mystic Water Board.

And it is further understood and agreed that the consumption of water for the public institutions at Deer Island shall be ascertained and computed by meters. And the parties to this contract further agree that if the City of Boston shall neglect to establish and continue water rents for the use of fire hydrants in other portions of that city, then it shall be privileged to locate as many fire hydrants throughout East Boston, as it may elect, to be used for fire purposes only, upon the annual payment to the City of Charlestown of the sum of twenty-eight dollars for each three hundred and fifty inhabitants; the payments from 1870 to 1875 to be based upon the population of 1870, and on and after 1875 each year for every five years upon the preceding semi-decennial census. In computing the amount, the fraction shall not be taken into account, unless it exceeds one half, when the full price will be charged; and it is further understood and agreed that the water supplied for public fountains shall be charged at cost.

And the said party of the second part further agrees to collect all the water rents which may accrue for the use of the water under this agreement, and pay to the said party of the first part, the following percentage thereof, in monthly payments, viz. : on the annual receipts for water rents up to the amount of \$20,000, eighty-five per cent. ; on the amount in excess of \$20,000, and up to \$30,000, eighty per cent. ; from \$30,000 to \$40,000, seventy-five per cent. ; from \$40,000 to \$50,000, seventy per cent. ; and on the amount in excess of \$50,000, sixty per cent.

And it is further agreed by and between the parties to this contract, that the said party of the second part shall cause separate books to be kept, showing in detail the number and names of all water-takers, the purposes for which used, and the amounts assessed and received for the same, which books shall be subject to the examination of

the Mystic Water Board, and all assessments of rates not specified in the Ordinances, and any abatement thereof shall be subject to the approval of the Mystic Water Board. And it is further agreed that the party of the first part may appoint inspectors, who, together with the Clerk of the Mystic Water Board and the Superintendent of the Charlestown Water Works, shall be authorized to examine and report all cases of waste and illegal and improper use of the water; one to be employed during the warm season, and two in the cold season, at a compensation not exceeding three dollars each per day, to be paid by said party of the second part.

And it is further agreed that for the collection of the rates as herein specified, there shall be allowed and paid to the said party of the second part, by the said party of the first part, the sum of twenty-five hundred dollars per annum.

And it is further agreed that the expense of opening the books and transferring the accounts necessary to carry out the provision hereinbefore specified, shall be borne by the party of the first part. And also that the party of the second part is not to be responsible (except rates actually collected) in any case for the payment of the said water rates, except for water furnished for public use to the City of Boston.

And the said party of the second part further agrees to furnish and deliver to the party of the first part a copy of a map of the district supplied, showing the streets on which the pipes are laid, and the location of all the pipes, hydrants and stop-gates, and from time to time make additions thereto as new pipes are laid.

And it is further agreed that this agreement shall go into effect on the first day of January, A. D. 1870.

And it is further agreed by and between the parties to these presents, that this agreement shall continue in force until the debt of Charlestown, which has accrued or may accrue for the construction of the Water Works, shall be extinguished, and until other and different rates are established as hereinafter provided. And it is further agreed that if, at the expiration of this contract, the parties shall be unable to agree upon terms for a continuance of a supply of water, the matter shall be referred to a commission of three disinterested persons, to be mutually agreed upon, and if unable so to agree, then by appointment of the Chief Justice of the Supreme Judicial Court.

And it is further agreed that if either of said parties shall omit or refuse to perform this contract in all things on their part, then the matter shall be referred to a commission, as before named, by whom an adjustment shall be made and a compensation determined for such violation of this agreement.

In witness whereof the parties to these presents have hereunto set their hands and seals on the day and year first above written.

In presence of

WM. W. PEIRCE.

[Seal.]

WM. C. PHELAN.

[Seal.]

EDWARD LAWRENCE,
JAMES DANA,
FRANCIS CHILD,
ABEL E. BRIDGE,
THOS. R. B. EDMANDS,
NATH'L. J. BRADLEE,
BENJ. JAMES,
ALEX. WADSWORTH,
FRANCIS A. OSBORN,
GEORGE LEWIS,
JOSEPH M. WIGHTMAN,
CHARLES H. ALLEN,

} *Mystic
Water
Board.*

} *Cochituate
Water
Board.*

Approved: NATH'L B. SHURTLEFF,
Mayor of the City of Boston.

Approved: EUGENE L. NORTON,
Mayor of the City of Charlestown.

REVENUE FROM HYDRANTS.

On September 17th the Mayor approved the following order :—

" *Ordered*, That the Joint Standing Committee on Water be requested to consider and report upon the expediency of providing for the payment of water used by the Fire Department in the extinguishment of fires."

On November 29th the committee made the following report (see City Doc. No. 96) :—

"For the purpose of showing the actual expenses of carrying on each department of the City Government, it has long been the rule for one department to charge another department for work performed, or material furnished, in the same manner as though the service was rendered by persons outside of the Government. In accordance with this rule, the various departments of the City Government, with the exception of the Fire Department, pay the established rates for water used by them.

"The value of the water works, in the means they afford for the protection of property from fire, should be recognized in providing the income for their care and management. Although it may not appear, upon the first glance, to be of much importance whether the expense is sustained by one department or another, it should be borne in mind that, if the Fire Department is charged for the use of water from hydrants in extinguishing fires, an appropriation will be made annually for the purpose, and put into the tax levy, thereby carrying out the established policy of the city, to meet all current expenses by taxation.

"The subject is the more important at this time, because, by the annexation of new territory, and the consequent increase of the population, the necessary extension and enlargement of the water works have caused the expenditures of this department to be so largely increased that, at present, the income is not sufficient to meet the current expenses and the interest on the debt.

"It is, therefore, a subject of grave concern how this deficiency ought to be provided for. To increase the water rates for domestic purposes is attended with so many objections that it is clearly the duty of the City Council to avoid it if possible.

"At all events, no action in this direction ought to be taken until all other means of income have been exhausted.

"The quantity of water used by each of the steam fire engines, when in operation, is from four hundred to six hundred gallons per minute; and it is not unusual for a million of gallons to be used at a single fire.

"The total number of hydrants established up to May 1, 1869, was as follows :—

Boston Proper	.	.	.	.	.	.	.	.	.	1,048
South Boston	.	.	.	.	.	.	.	.	.	345
East Boston	.	.	.	.	.	.	.	.	.	198
Boston Highlands	.	.	.	.	.	.	.	.	.	142

"The cost of the hydrants, and keeping them in order, as well as supplying the water, has heretofore been met by the water department.

"The subject has already received attention in other places, and from the responses to a circular addressed to the Water Commissioners in other cities, it has been ascertained that, in fifteen cases of twenty-six, direct compensation is made for the water used by the Fire Department.

"In some cases a specific tax is levied upon the property; in others, each hydrant and reservoir supplied from the water works is charged at a certain rate per annum. In the city of Worcester, this rate is twenty-five dollars each; in Hartford, the rate is thirty dollars each; in Cambridge, thirty dollars each; in Charlestown, Chelsea, and Somerville, twenty-eight dollars each; in Louisville, Kentucky, fifty dollars each; while in Cincinnati, Cleveland, Buffalo, and some other western cities, special annual appropriations are made, varying from thirty thousand to fifty thousand dollars, for the supply of water at fires.

"In the recent contract made by the Cochituate Water Board with the Mystic Water Board, for the supply of East Boston, the charge for water used from hydrants, provided the City Council of Boston do not establish any rates, is twenty-eight dollars for every three hundred and fifty inhabitants. If a rate is established by the City Council, then the Mystic Water Board receives the same proportion of the amount collected that it does upon the water rents in other cases.

"If, therefore, the City Council do not authorize the Cochituate Water Board to charge for the water used by the Fire Department, by assessing a certain rate upon the hydrants, special provision will be necessary to meet this expense in East Boston.

"For the reasons herein presented, your committee are of opinion that it is expedient for the City Council to authorize the Cochituate Water Board to charge the sum of eighteen dollars per annum for water used by the Fire Department from each hydrant and reservoir, and twelve dollars per annum for furnishing and keeping in repair the hydrants and reservoirs.

"So far as the committee have been able to judge from the facts presented to them in regard to the amount of water used and the expense of furnishing and repairing the hydrants and reservoirs, these charges would be just and equitable.

"They would, therefore, respectfully recommend the passage of the accompanying ordinance.

"For the Committee,

"W. E. HAWES, *Chairman.*"

See another report at some length on this subject, Jan. 1876.

The result of this report was the passage of an ordinance Dec. 10th, 1869 (see Part Fourth, "Ordinances"), requiring the Fire Department to pay \$30 a year for each hydrant.

November 9th. A leak was discovered in the east-pipe chamber, at Charles river, caused by settling of the earth. It was repaired before any damage was done.

November 17th. It was voted by the Board, "That on and after this date no hydrant or tap be allowed to be located outside of any building, unless specially authorized by this Board."

December 3d. A communication was received by the Board, from the Jamaica Pond Aqueduct Co., proposing to sell their property to the city for \$225,000. It was voted not to accept the proposition.

December 24th and 25th, the water was shut off from East Boston, when it was found that the consumption for one day, determined by measuring the loss in the reservoir, was 882,215 gallons, or 35 gals. per head.

1870.

January 1st. The Cochituate water was shut off from East Boston, and the Mystic water let on. It was expected by some persons that the extra pressure might lead to leaks, but only one was detected. (See Mr. E. R. Jones' report, City Doc. No. 51.)

January 17th, the following gentlemen were elected, by the City Council, members of the Water Board for the present municipal year :—

Alderman	.	.	WALTER E. HAWES.
Common Council	.		JOHN O. POOR,
"	"	.	HOLLIS R. GRAY.

The following committees were appointed by the President :—

Water Reg's Dep't. — Messrs. WIGHTMAN, HARRIS and ALLEN.
 Eastern Division. — " LEWIS, WIGHTMAN and POOR.
 Western " " ALLEN, HAWES and GRAY.
 Construction of C. H. Res. — The PRESIDENT and Messrs. LEWIS and ALLEN.

January 31st. An order passed the City Council, requesting the Committee on Water to report the expediency of causing all service-pipes hereafter laid to be constructed in such a manner as to permit the water to be shut off beneath the sidewalk, instead of the roadway as at present.

March 7th the committee reported :—

"The main, if not the only, objection to the present system of constructing the service pipes is the necessity of digging up the streets, and thereby obstructing travel whenever the water is shut off for non-payment of the rent. When the water was first introduced, in 1846, cocks were placed under the sidewalk; but, on account of the extra expense, and for other reasons, the system was changed about the year 1858. The iron mains are now laid in the street, and a brass cock is screwed into them to which the lead service pipe is attached by a coupling. If any accident occurs to the lead pipe the water is shut off at the main. If there was no cock at the main any injury to the service pipe, between the cock under the sidewalk and the main pipe in the street, would necessitate shutting the gates in the main until the service pipe was repaired, thus depriving the occupants of a whole street, or even a considerable district, of water. The cost of putting an extra cock under the sidewalk would be about three dollars. There are many disadvantages in having a shut-off under the sidewalk, as the box often gets filled with water, the covers are frequently removed, and much injury is caused by mischievous boys. Where there are vaults under the sidewalks, for mechanical purposes, or for the storage of coal or goods, it would be difficult or impossible to carry out the plan proposed. The aperture in the sidewalk would also increase the liability of the service-pipe to freeze and burst. The Boston Gas Light Co. have abandoned the plan of inserting cocks in the sidewalks, probably for the

same reasons which influenced the Water Board. Undoubtedly many of the openings in the streets for which the Water Department has been criticised were made by the Gas Co. The whole number of times in one year that the water has been cut off and let on, on account of non-payment of rent, amounts to five hundred and twenty-five. This seldom occurs in the business portion of the city. It is generally only in the districts where the poor classes reside, and where the streets are not paved. In view of the foregoing statements the committee are of the opinion that it would be inexpedient to change the present system, and they would, therefore, report that the order ought not to pass.

“ For the committee,

“ WALTER E. HAWES,

“ *Chairman.*”

The order was not adopted.

February 2d. The Board voted it inexpedient to allow any parties to take ice from Chestnut Hill Reservoir.

February 10th. Mr. William F. Davis reelected Water Registrar by the City Council.

March 5th. The Board received notice that the machine shop had been damaged by fire. The damage was small; and, in rebuilding, two additional stories were added.

March 14th. An order was introduced into the Council directing the Committee on Water to report whether some means cannot be devised to reduce the high rates for water furnished dwellings. The committee reported that sections 11 and 12 of chapter 167, of the Acts of 1846, require the Council to establish rates which will pay the interest on the water debt, and the expense of maintenance.

No action was taken.

The following order by the Council was approved April 1st:—

Ordered, That the Water Registrar be directed to certify to the Cochituate Water Board the amount of monthly receipts from the takers of Mystic water, in this city; and that the said Water Board be directed to draw upon the City Treasurer their warrants for the payments to the city of Charlestown for the amounts due monthly for the use of said water; and that the City Treasurer of Boston be directed to pay said amounts, thus certified and allowed, to the proper authorities in Charlestown, authorized to receipt for the same.

April 20th. The Board voted to supply the Mount Warren Water Co. with water from April 1st to July 1st, for 80 per cent. of their receipts.

April 21st and 27th. The conduit was examined by the Mayor and others.

May 4th. The Board sent a letter to the Council asking \$125,000 for Wards 13, 14 and 15, the petitions for main pipe extensions having far exceeded all anticipations.

Official notice having been received of the election, at large, of Messrs. George Lewis and John A. Haven to the Board, for two years from the first Monday in May, the members of the Board were called to organize, May 2d.

The following officers were elected : —

President,	NATHANIEL J. BRADLEE.
Clerk,	SAMUEL N. DYER.
Clerk of Committees, . . .	WILLIAM C. PHELAN.
Supt. Western Division, . .	ALBERT STANWOOD.
Supt. Eastern Division, . .	EZEKIEL R. JONES.

The President appointed the following committees : —

Water Reg.'s Dept. — Messrs. POOR, HAWES and ALLEN.	
Western Division. — “	ALLEN, HAWES, and GRAY.
Eastern “ “	LEWIS, HAVEN and POOR.
Chestnut Hill Reservoir. — The PRESIDENT, and Messrs. LEWIS and ALLEN.	

The pay of the Superintendents was fixed at \$3,000.

The President and Committee on Eastern Division were authorized to contract for pipes for Wards 13, 14 and 15, and for Deer Island.

It having been debated for some time whether to lay a cement-lined pipe or a cast-iron pipe to Deer Island, the Board voted, May 18th, to lay a cast-iron pipe.

The Board, in their Annual Report to the City Council, report 1,419 water-takers in Roxbury.

They recommend the transfer of \$1,300,000* from the water debt to the city debt, “as it would not more than compensate this department for the benefit derived by all the citizens for the use of the water by the Fire Department, and for other public uses since its introduction in 1848.” If this change were made, they represent that the Water Department could be made self-sustaining, and, in time, a sinking fund established. During the past year there has been laid 89,259 feet of main pipe.

The two large mains on Tremont street, between Castle and Pleasant streets, 1,700 feet in length, have been raised, including pipes on the Bridge over the B. & A. R.R.

2,205 service pipes have been laid.

The stand-pipe has been completed.

* The actual amount transferred was \$1,352,000. (See City Doc. No. 57, 1871.)

Also, the engine-house in Elmwood street.

Pumping-engines and boilers are in working order.

A telegraph line has been laid through the conduit to the lake.

36" and 30" gates have been put in the pipes, just outside of the Brook line gate-house, on a line with the 40" gate.

During the fall of 1869, the connections with the 48" pipe, from Chestnut Hill reservoir, were put in.

The principal work to be done on the lower basin, at Chestnut Hill reservoir, is the "completion of the embankment on the easterly, and on each side of the effluent gate-house." The gate-house is completed to the top of the principal floor.

The driveway has been completed its whole length, with the exception of some gutter paving.

The foot-path is now being graded.

The gateway is finished to the top of the centre arch.

They estimate that there are at least one hundred and seventy-five places in the city of Boston where there is a liability of waste of water.

The City Engineer, Mr. N. Henry Crafts, in his report, says: "The average effective head in East Boston for the past nine years has been that due to a height of about 95 feet above tide-marsh level, or mean high water. The present effective head, as the works are now arranged for ordinary use, is increased from 10 to 12 feet, while in case of an extraordinary demand, a still further increase of 20 feet can be obtained."

"On the 17th and 18th of February last, when the full pressure of the Mystic water was on the distribution pipes in East Boston, observations were made hourly of the pressure as indicated by a gauge connected with the Meridian-street pipe, and it was found that the average day pressure, that is, from 6 o'clock A.M. to 6 o'clock P.M., was $36\frac{3}{10}$ pounds at the level of the gauge, which was 48.55 feet above tide-marsh line, making the total effective head above mean high water 132.18 feet. During the time of greatest draught (at 12 o'clock M. of the 18th), the gauge indicated 34 pounds, showing an effective head above tide-marsh level of 126.89 feet. Maximum high water in the Charlestown reservoir is 147.00 feet above tide-marsh level; therefore the loss of head from the Charlestown reservoir to East Boston, during the hour of greatest draught, was about 20 feet. This loss will be reduced very materially by the laying of a larger main from Charlestown Neck to the square, as proposed by the Mystic Water Board."

Mr. Crafts calls the attention of the Board to a plan by Mr. E. R. Jones, to connect the Roxbury high service to the Beacon high service,

which will save an independent line of pipes.* This plan includes using the 30" main as a high-service main.

The pumping engines are supplying the Highland and Mt. Warren Districts, and the average pumping time per day is only 2 hours 42 minutes.

The Superintendent of the Western Division reported that the water had been shut off from the conduit eight times during the year.

June 28th. The City Solicitor gave an opinion, "That the Water Board have no authority to assess water-rates upon vacant lots."

EXTENSION OF PIPES TO DORCHESTER.

This new territory, annexed Jan. 3, 1870, was canvassed with a view of ascertaining the probable number of water-takers. Circulars were sent to the inhabitants, and out of 506 responses, —

174	answered	yes.
206	"	no.
126	"	doubtful.

The City Engineer made a report and estimate of the probable cost. His plan included only those streets which would pay 6 per cent. interest on the cost of a 6-inch cast-iron pipe, calling the cost thereof \$1.80 per running foot, all laid, and reckoning an income from each house of \$10. The estimate for the cast-iron pipe was \$273,383, and for a cement pipe \$220,721. A petition was subsequently presented to the City Council by residents of the ward, asking for water. The Committee on Water advised with the Water Board, who recommended, July 6th, that in their opinion it was expedient to supply the water. On July 14th the committee recommended granting the petition by laying cement-lined pipes in the new ward. On July 19th the Mayor approved an order authorizing an appropriation of \$375,000 for laying mains, service pipes and hydrants in this ward, and to connect the main at Upham's Corner with the South Boston reservoir.

The Board then investigated the subject of cement-lined pipes by a committee appointed for that purpose. This committee reported (Aug. 17th) in favor of cast iron, which was adopted. A contract was accordingly made, at \$53 per ton, delivered.

* Carried out, and water let in June 4.

INCREASE OF CAPACITY OF PIPES IN EAST BOSTON.

On Aug. 29th the Joint Standing Committee on Water of the City Council made a report recommending certain changes of pipes in East Boston for fire purposes. (See City Doc. No. 79.)

On Sept. 5th the matter was referred to the Water Board.

On Oct. 20th the Board made a report to the City Council (see City Doc. No. 92), recommending the substitution of 12-inch for 6-inch in certain streets, and the following order was passed: —

"Ordered, That the Cochituate Water Board be authorized to lay water pipes in Border, Sumner, Lewis and Marginal streets, in East Boston, the expense thereof not to exceed the sum of \$21,000, and to be charged to the appropriations of the Fire Department."

Aug. 17th. The Board authorized the laying of main and service pipes from the Highland District to Upham's Corner, and mains from Upham's Corner to South Boston reservoir.

The Committee on Western Division were authorized to enlarge the culvert at Cobb's crossing, in Natick.

Nov. 17th. Mr. Joseph A. Wiggin was elected Assistant Clerk.

Dec. 24th. An order was approved directing the Mayor to petition the General Court for authority to lay a new main from Chestnut Hill reservoir, through Beacon street, to the city.

An act was obtained and accepted by the city July 18th, 1871. (See Part Fourth.)

1871.

January 4th. Mr. Nathaniel J. Bradlee sent in his resignation, and Mr. Charles H. Allen was elected President of the Board.

It was *Voted*, That the thanks of the Board be, and they hereby are, presented to Nathaniel J. Bradlee for the able, impartial and dignified manner in which he has discharged the duties of his office as President of this Board; also, that a copy of Mr. Bradlee's remarks be obtained, copied upon the records and published.

In the course of these remarks, Mr. Bradlee refers to the prosperous financial condition of the works, and the great amount of work accomplished by the Board during the three preceding years, which, he says, "has exceeded all which was performed since the works were surrendered by the Commissioners eighteen years ago.

"From 1850 to 1867 there were forty-one miles of main pipes laid, and from 1867 to the present time there have been forty-eight miles laid; and the increase in the number of service-pipes and water-takers has been *equal* to the fifteen years previous."

In regard to the terms of office of members of the Board, Mr. Bradlee says:—

"There is, in my opinion, a serious mistake in regard to the election of members of the Board for so short a time; there is but one member of the present Board, besides myself, who was elected three years ago, and only three of us were members three years ago; and to-day three of our members leave who have served but one year."

Mr. Bradlee recommends a change in the ordinance "so that the members chosen at large should be elected for four years, one retiring each year. This would prevent the Board being wholly composed of persons of little or no experience."

January 23d. Mr. Leonard R. Cutter, of the Board of Aldermen, and Messrs. Sidney Squires and Amos L. Noyes, of the Council, were chosen members of the Water Board for the municipal year.

February 1st, the following committees were appointed:—

Eastern Division. — Messrs. LEWIS, HAVEN and SQUIRES.

Western Division. — The PRESIDENT, and Messrs. CUTTER and NOYES.

Water Registrar's Department. — Messrs. HAVEN, ALLEN and SQUIRES.

Chestnut Hill Reservoir. — Messrs. BRADLEE, LEWIS and ALLEN.

February 16th. Mr. William F. Davis re-elected Water Registrar by the City Council.

February 18th. The following water-rates were adopted by the Board:—

The charge for each lodging room, in which there are no fixtures, shall be two dollars per annum.

For each room with water-fixtures, three dollars per annum.

For each water-closet used in common, five dollars per annum.

A committee was appointed to consider the expediency of purchasing the Jamaica Pond Aqueduct.

March 1st. It was voted to authorize the Superintendent of Eastern Division to make a connection in Marginal street, Chelsea, for the city of Chelsea, the city of Boston reserving the right to open and close the stop-cock whenever it may deem it expedient.

April 19th. *Voted*, That it is inexpedient to allow the Jamaica Pond Aqueduct Co. to supply water within the old city limits.

April 29th. Water from the Mystic works was let into the pipes to Deer Island.

Messrs. N. J. Bradlee and Charles H. Allen having been chosen, April 3, members of the Board for two years from the first Monday in May, the Board was called together May 1st, to organize.

The following officers were chosen : —

President. — CHARLES H. ALLEN.

Committee on Western Division. — The PRESIDENT, and Messrs. CUTTER and NOYES.

Committee on Eastern Division. — Messrs. LEWIS, HAVEN and SQUIRES.

Committee on Water Registrar's Department. — Messrs. HAVEN, ALLEN and SQUIRES.

Chestnut Hill Reservoir. — Messrs. BRADLEE, LEWIS and ALLEN.

The same superintendents were elected.

May 8th. Mr. S. N. Dyer and Mr. W. C. Phelan resigned their offices as Clerk, and Clerk of Committees, and Mr. Joseph A. Wiggin was elected to the office of Clerk.

The salary of the Clerk was fixed at \$2,500.

May 18th. The Board made their annual report.

They refer to the anxiety felt on account of the long-continued drought. Pumps* had been procured, but had not been used, as the lowest point reached, by the water at the lake, Feb. 18, '71, was 4 feet 10 inches. They report a change made in the sinking fund of the city by which the sum of \$1,352,000 had been credited to the Water Works.

129,040† feet of main pipe have been laid, and 2,224 service pipe.

A 20-inch main has been laid from Upham's Corner to South Boston reservoir.

A 16-inch main has been laid through a portion of Charles street, and a line of 12-inch laid on the Common to the Frog pond.

A new dam has been built at Pegan brook, and the bed cleaned out.

Willow bridge, between the basins of the lake, built.

Gate-chamber, at Dudley pond, reconstructed.

The members of the Board have had meters put on to their service pipes, and, from observations continued for more than a year, the average consumption was found to be 25 gallons per head in 24 hours.

The descriptions of Chestnut Hill reservoir will be found embodied in *Part Third*.

RELAYING OF PIPES IN THE SUFFOLK-ST. DISTRICT.

May 19th. The Mayor approved the following order : —

Ordered, That the Cochituate Water Board, under direction of the

* For full history of these pumping operations see farther on under 1872.

† This includes 27,488 feet laid by contract to Deer Island.

Committee on Suffolk-st. District, be authorized to relay water-pipes on the Suffolk-st. District, the expense to be charged to the appropriation for the improvement of said district.

NEW MAIN TO EAST BOSTON ACROSS CHELSEA CREEK.

Oct. 27th, 1870, the Water Board sent a letter to the Council, asking for \$25,000 to lay a new pipe, in place of the broken one, across Chelsea creek. (See City Doc. No. 99.) In this report is a letter from the City Engineer, recommending a new 24-inch pipe, and giving an estimate and reasons therefor.

East Boston received her supply through a 20-inch submerged pipe across Chelsea creek. In August a leak was detected in the pipe, and the services of a diver engaged, who reported "a crack in one of the straight flanged pipes immediately under the bolts and close to the flange. The crack was 18 inches in length, extending partly around the pipe, and the opening was not more than a sixteenth of an inch in width. The water issued in a sharp stream and with great force, manifesting itself by ebullition at the surface."

Nothing could be done without endangering the water supply, whence arose the necessity for a new pipe. An examination was made of that portion of the pipe which is laid upon piling above low-water mark from the channel on each side to the adjacent streets. These portions of the pipe were scraped, chiselled and drilled at various points, and in no place was there found to be less than $\frac{3}{4}$ inch of good iron.

On Nov. 9th an order of the Council was approved for a new pipe across Chelsea creek, and providing for the transfer of \$25,000 from the reserved fund to meet the expense.

On Nov. 10th the Board voted to accept the proposal of Geo. S. Norman to furnish and lay the pipes, and repair the old line for the sum of \$24,000.

The new line is 24 inches in diameter.

Early in 1871 the flexible portion of this main, 650 feet in length, which had been put together on skids, on the East Boston flats, was sunk. "Before launching it the water was drawn out of the pipe at low tide, and the ends plugged. A sufficient number of empty kerosene barrels were lashed to the top of the pipe to float the empty pipe, being placed in couples along the entire length. The pipe was then filled, the ends plugged again, and the joints all tested by connecting the 20-inch main. Everything was found to be tight, and the pipe was kept sunk for several days awaiting a seasonable tide and a calm day. The first trial

was not successful, owing to a slight opening of one of the joints which permitted the tide-water partially to fill the pipe, and cause it to sink at the middle of the line and drag on the flats. The difficulty was subsequently remedied, and upon the next favorable opportunity, which occurred April 18th, the pipe was successfully launched and sunk in the trench prepared for it."

This method was devised by Mr. Norman. The trench, which had been dredged, was about six feet in depth.

After sinking this portion of the pipe it was decided by the Board to continue the main across the flats on each side of the creek, on pile work, which was done for the sum of \$13,000, by Mr. Norman.

The whole length of the new line was 1,463½ feet. It was connected with the old 20-inch line at the ends. The leak in the old pipe was then successfully stopped by Mr. Norman. The earth was first dredged and dug away, leaving the pipe exposed, when it was found that the crack extended nearly half round the pipe and close to the flange. This crack was filled with pine wedges and covered with an India-rubber band, secured by iron clamps to the pipe and the flange on each side of the crack. The whole work was done by a diver, and about three weeks were occupied in performing it.

Both lines were tested by meters after the completion of the new one, and the repair of the old one, and they were found to be substantially tight.

It was ascertained by meter measurement that the amount of the leak was 192,000 gallons per day when the pressure was on, but as this was not on more than half the time the average actual loss could not have exceeded 100,000 gallons. (See City Doc. No. 15, 1871.)

June 7th. The Board voted, in view of the scarcity of water, "that no new applications for the use of hand hose be granted."

July 18th. The Mayor approved an order accepting the act entitled "An act in addition to an act to authorize the City of Boston to build an additional reservoir." Passed April 14, 1871.

This act was to give authority to the city to lay new mains. (See Part Fourth.)

Sept. 6th. The Board voted, "That in all cases where water is used for motive power, in elevators or other machinery, that meters be applied, the takers to pay all expense in addition to the regular water-rates, with the understanding that the supply shall be cut off whenever the Board shall deem it expedient, to keep up the supply for domestic purposes."

Sept. 22d. The interior of the gate-house at the lake lined with bricks.

Oct. 6th. The Mayor approved an order authorizing the laying of 12-inch pipes in East Boston, in Border, Sumner, Lewis, and Marginal streets.

Oct. 14th. Walls at lake, near gate-house, rebuilt.

DEPOSIT REQUIRED BY BOARD.

On account of losses incurred by the Board for materials and labor furnished for work done outside of the department, but connected with the Water Works, it was voted, Oct. 14th, "that on and after this date, no materials or labor shall be furnished, unless the person or persons requiring the same shall make a deposit with the clerk of the Board of a sufficient sum to cover the total cost of said labor and material, the amount to be adjusted on completion of the work."

Early in December the screens at Chestnut Hill reservoir were stopped by anchor-ice, causing a slight water panic in the city.

BEACON HILL RESERVOIR.

On Dec. 21st an order passed the Council, asking the Board to consider whether Beacon Hill reservoir is longer needed.

On Dec. 23d the Board held a meeting, at which residents in the vicinity of the reservoir were present and remonstrated against its removal. The Board voted that "they deemed it best to delay for the present any action on their part towards recommending its sale or discontinuance."

1872.

Feb. 5th. Mr. Leonard R. Cutter, of the Board of Aldermen, and Messrs. Amos L. Noyes and Charles H. Hersey, of the Common Council, were elected members of the Water Board for the municipal year.

Mr. Hersey was appointed, Feb. 7th, on the Committee in Eastern Division and Water Registrar's Department, in place of Mr. Squires.

Feb. 7th. The Board voted, "That when meters are applied to ascertain the quantity of water used, the rates shall in no case be less than the specific rates."

Feb. 8th. Mr. William F. Davis re-elected Water Registrar by the City Council.

BREAK IN THE FORTY-EIGHT-INCH MAIN.

On Friday, Feb. 15th, a break occurred in the 48-inch pipe, close to the crossing of the B. H. & Erie railway. Serious damage was threatened, but owing to the prompt action of Mr. Daniel W. Wise, who gave notice of the break, the water was shut off in time to prevent any great loss of property beyond washing out the railway and flooding the brook. The Board voted its thanks to the superintendent and his assistants for their promptitude, and presented Mr. Wise with a mantel clock, at a cost of \$150, in recognition of his services.

In regard to this break, Mr. E. R. Jones says (City Doc. No. 78), "A piece of the pipe was thrown out some 4 feet in length, and nearly one half the circumference of it. An examination of the break was made, which showed the pipe to be perfectly sound, except what appeared to be an old check in the bead of the bell, about 2 inches deep. This, however, was so slight as to be hardly perceptible. The probability is, there being a leak in the joint of the pipe next to the one broken, and the gravel washed from under it, made a lever of this pipe that pried out the large piece of the other."

The Board passed the following vote:—

"That in all cases of frost, the Superintendent of Eastern Division shall open all main pipes first, then those that are on a line with the streets, then those that are nearest the streets, leaving to the last those that are most remote from the street."

PUMPING AT THE LAKE DURING 1871-72.

During the last part of the year 1870, the water level of Lake Cochituate lowered rapidly, owing to a long-continued drought. The average height for the month of June was 13.02 feet above the bottom of the aqueduct* while the average for December was but 6.40 feet. On January 1st, 1871, the water had fallen to a point $6\frac{1}{2}$ inches below the top of the aqueduct, and the greatest anxiety prevailed among the officers of the Board, lest the citizens should suffer from a short supply. It was evident that not only would the reservoirs become drawn down to a point of danger, should the lake keep on falling, but it might become extremely difficult to fill them again. Early in January the Board determined to resort to pumping at the lake to keep up the height of water in the conduit. On January 12th, 1871, Mr. Henry M. Wightman, Assistant City Engineer,

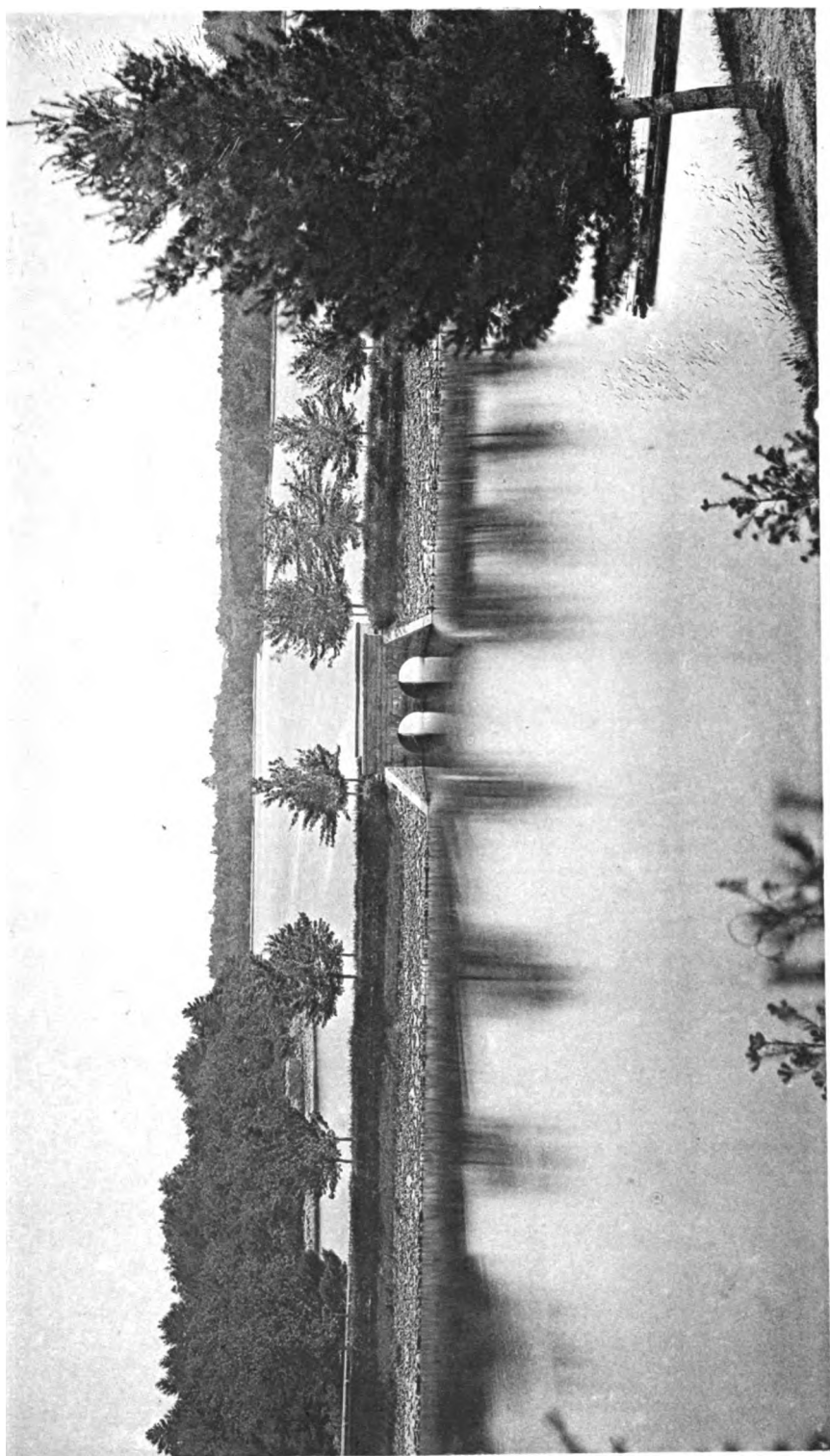
* High water is 13 feet 4 inches above the bottom of the aqueduct.

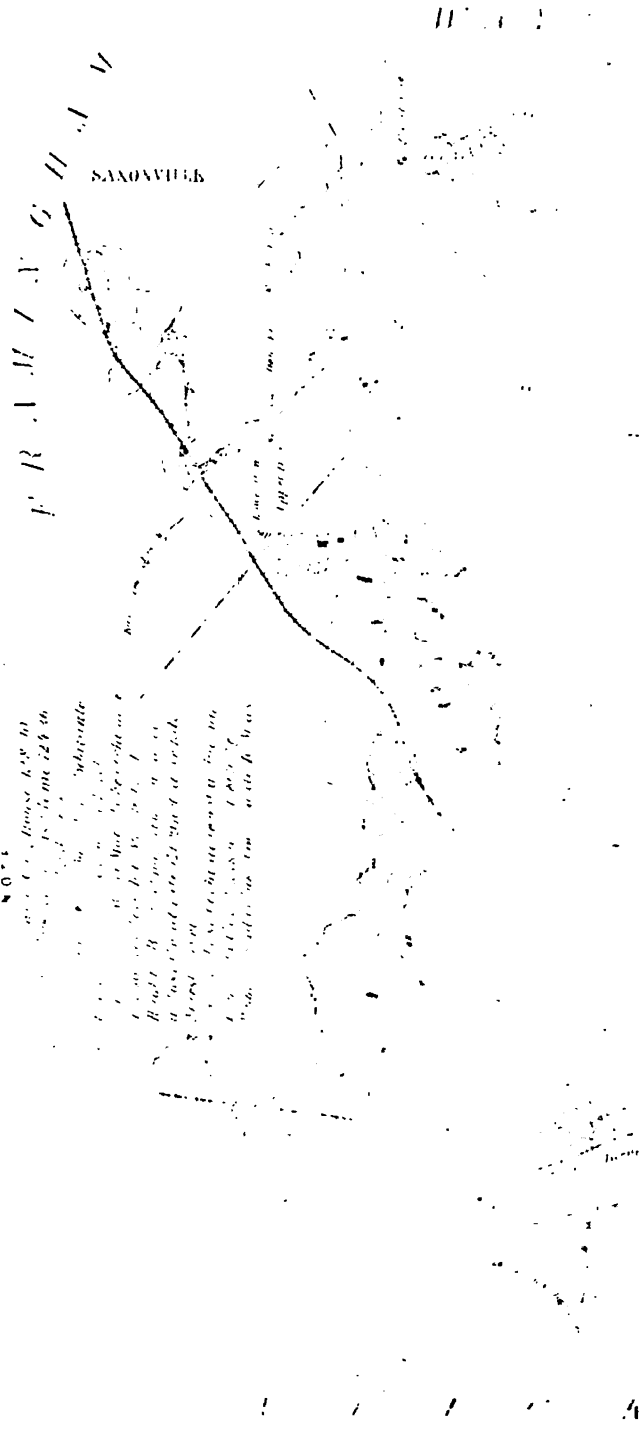


...the pipe close to the ... was threatened, ... gave notice ... great loss of ... too break. The ... assistants for four ... clock, at a cost of ...
 ... L. W. Jones says (Copy Book No. 78), ... as the wires are 4 feet in length and nearly ... of the ... of the break was made, ... what appeared to be ... This, however, was ... there being a ... the gravel washed ... the large piece of

... Eastern Division ... on a line with the streets, ... last those that are

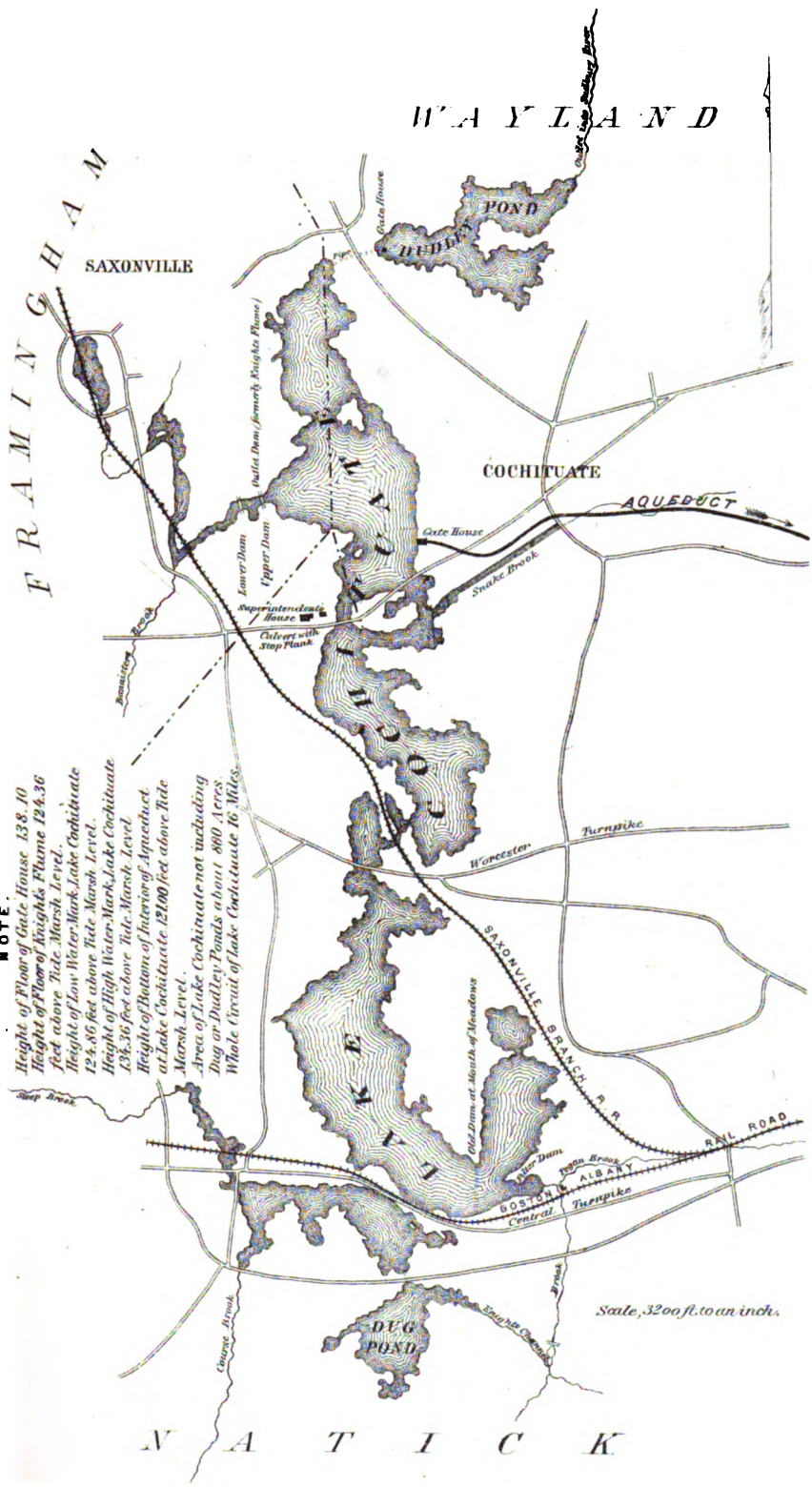
... Lake Okechobee ... The ... of the ... On ... the top of ... of the ... It was evident ... down to a point of ... extremely difficult ... to resort to ... water in the conduit. On ... Assistant City Engineer,





NOTE.

Height of Floor of Gate House 138.10
 Height of Floor of Knight's Flume 124.36
 Feet above Tide Marsh Level.
 Height of Low Water-Mark Lake Cochituate
 124.86 feet above Tide Marsh Level.
 Height of High Water-Mark Lake Cochituate
 134.36 feet above Tide Marsh Level.
 Height of Bottom of Interior of Aqueduct
 at Lake Cochituate 121.00 feet above Tide
 Marsh Level.
 Area of Lake Cochituate not including
 Dig or Dredge Ponds about 880 Acres.
 Whole Circuit of Lake Cochituate 16 Miles.



was authorized to procure the necessary machinery. Two pumps were purchased of the Water Commissioners of Salem, and arrived at the lake January 15th. On the 16th an engine was purchased at Lawrence. These pumps were put in running order inside of the gate-house, to be run by the engine on the outside, but as the water increased instead of diminishing, they were allowed to remain idle until November.

At this time, the water having receded to a point where the supply could not be kept up to the city, Mr. Wightman was again requested by the Board, November 4th, to take charge of the pumping, and on the 11th the supply by gravitation was cut off, and the pumps started; but proving inadequate, a third 12-inch pump was put in, and the stone-crusher engine sent from the reservoir to run it. The three pumps were started December 9th, and were run continuously, night and day.

While these pumps were running, preparations had been made to meet another contingency. The pumps, being located inside the gate-house, could be used only as long as the water was at sufficient height in the chamber to cover them, and, as they were not suction pumps, would be useless in case the water level should fall 3 feet. Piles had therefore been driven in front of the gate-house, platforms constructed, and contracts made for the building and delivery of two twenty-five horse-power engines and two pumps of greater capacity than those in use. One of the engines arrived on the 7th of December, was placed on the platform, and a building erected over it. The first pump did not reach the lake until the 25th of December; on the 30th it was run for the purpose of testing it, and a trial of its capacity in comparison with the three pumps was made January 6th, 1872, and found to be equal to the three. It was not, however, deemed advisable to start this pump until the second one was in position.

The second engine arrived the 14th, the second pump the 15th of January; on the 26th the buildings were completed, the engines and pumps in running order, and they commenced pumping the supply for the city. The pumps which had been in use were stopped, but were left in position ready for service in case of accident to the others. All the pumps used were of the kind known as the "Perry Centrifugal," the ones first run having 12-inch discharge pipes, and the others having 18-inch discharge and 22-inch suction pipes. The latter, with a velocity of 120 revolutions, were each capable of lifting 14,000,000 gallons in 24 hours. This amount could be largely increased by increasing the speed of the pumps. The supply was furnished by these pumps until the 2d of April, when one of them was stopped; the other one was run until the 13th, at which time, the water having reached a sufficient height to furnish the daily consumption by gravitation, pumping was suspended.

The lowest point reached by the water in the lake during this period was $9\frac{1}{2}$ inches above the bottom of the conduit. This was on the 29th of March, 1872, but from this time the water gained so fast that on the 1st of May it stood at 5 feet $3\frac{1}{2}$ inches.

By this temporary machinery the threatened water famine was averted. It not only supplied the daily consumption, but raised the level of Chestnut Hill reservoir 7 feet $9\frac{3}{4}$ inches, and the Brookline reservoir 3 feet 2 inches, making a total of 2,266,654,000 gallons pumped.

April 2d. The Board voted to supply Taft's Hotel, Point Shirley, with water, on condition that Mr. Taft will pay the expense, and submit to the same rules and regulations in regard to water and water-rates as other hotels.

May 2d. It was voted by the Board to establish six hydrants in Brookline.

April 8th. Mr. N. J. Bradlee resigned, and the Board passed the following resolution May 4th : —

Resolved, That the resignation of Nath'l J. Bradlee, Esq., has been learned with regret by the remaining members of this Board ; that they wish hereby to express their lively sense of the great value of his nine years' continuous service in the interests of the citizens of Boston, both as a member and president of the Board ; and on his retirement they tender him, with the profoundest respect for his character as a gentleman, their gratified thanks for his uniform courtesy and kindness, with earnest wishes for his continued health and prosperity.

April 15th. Messrs. John A. Haven and Edward A. White were elected by the City Council members of the Board for two years, from the first Monday in May.

May 2d. Mr. Alexander Wadsworth was elected for one year, in place of Mr. N. J. Bradlee.

May 6th. The Board was called together to organize, when the following officers were elected : —

President. — CHAS. H. ALLEN.

Eastern Division. — Messrs. HAVEN, HERSEY and WHITE.

Western " " WADSWORTH, CUTTER and NOYES.

Water Reg's Dep't. — " WHITE, HERSEY and ALLEN.

New Supply of Water. — PRES'T and Messrs. HAVEN and WADSWORTH.

Chestnut Hill Reservoir. — Messrs. CUTTER, NOYES and HAVEN.

Sup't Eastern Division. — E. R. JONES.

Sup't Western Division. — ALBERT STANWOOD.

Clerk. — J. A. WIGGIN.

In their annual report to the City Council, the Board refer to the following matters :—

The steps taken to secure an additional supply of water.

The selection of Mr. Joseph P. Davis to take charge of the engineering.

The subsequent choice of Sudbury river as a source of supply.

The laying of 133,830 feet of main pipe and 2,275 service pipes.

Water turned into the 48-inch main from Chestnut Hill reservoir in June, 1871.

The connection of the high service of South Boston with the Dorchester high service, nearly completed.

Sea-wall adjoining the gate-house at the lake has been rebuilt.

Completion of the new main to East Boston.

The freezing of the 10-inch pipes on Winthrop bridge twice during the winter.

Work commenced in the spring lowering the mains over Bradley's hill, Brookline.

Pipes in the Fort Hill District taken up.

New pipes for the Suffolk-street District mostly laid.

Channels deepened between the different divisions of the lake.

New steps built at Newton Lower Falls.

Blacksmith and carpenter's shop built at Chestnut Hill reservoir.

In this report will be found a report from Mr. Jos. P. Davis on a new supply of water in which he gives a description of the new works under progress.

The City Engineer, Mr. N. Henry Crafts, gives a description and estimate for a new 48-inch main from the reservoir by way of Harvard street and Longwood avenue, Brookline.

June 6th. Mrs. William Appleton having offered to defray the expenses of a stone watering-trough at the corner of Beacon and Charles streets, the Superintendent of Eastern Division was authorized to place one there, in accordance with her request.

A few months later Mrs. Appleton supplemented this gift by a subscription for the erection of ten water-troughs.

Measures were taken to establish a telegraph line from City Hall to Chestnut Hill reservoir, and also to Lake Cochituate.*

* A telegraph line on poles has been built as far as the reservoir. The old cable laid in the aqueduct has been taken out.

The Board voted that the Committee on Eastern Division be authorized to make arrangements with the Paving Department to place edge-stones and a sidewalk on two sides of the East Boston reservoir, one-half of the expense to be charged to the Water Works.

Voted, That the Clerk be authorized to notify the Committee on Common and Squares that this Board consider the ownership and care of the drinking-fountains upon the Common, and the apputrenances connected therewith, as vested in that committee, and therefore decline to assume any obligation or direction in matters of maintenance or repairs.

TEMPORARY SUPPLY FROM SUDBURY RIVER — 1871-72.

On October 20th, 1871, the Mayor approved an order appropriating \$10,000 for the use of the Cochituate Water Board in making surveys and inquiries in regard to an additional supply of pure water. On Nov. 15th, the Board secured the services of Mr. Joseph P. Davis as Engineer, and on Nov. 22d, Mr. Davis began his work of making surveys, estimates, plans, etc., for the new supply. Among the instructions given the Engineer by the Board was the following: "To make an examination of all the feasible sources of water supply within fifty miles of Boston, with reference to several matters, among them the immediate necessity of a temporary additional supply to avert the threatened deficiency of the coming season.

On Feb. 13th, 1872, Mr. Davis made a verbal report to the Board, and on April 6th, in consequence of the recommendation of the Engineer, the "Sudbury River Act" was secured. On the same day the Board directed Mr. Davis to begin at once the work of making a temporary connection between the Sudbury river and Lake Cochituate. This work comprised briefly — a dam in the river to turn the water into Farm pond and a channel from Farm pond into Beaver Dam brook, the principal tributary of the lake. We are indebted to Mr. Davis' report for the following particulars in regard to this connection.

Farm pond lies in the village of South Framingham, a little over a quarter of a mile from the Sudbury river. Its water surface is 200 acres in area, and its outlet before the works were carried out was into the river, through a brook which flowed in a northwesterly direction.

In the summer season the surface of the water in the pond stood two or three feet higher than that in the river, but during the fall and spring freshets the river rose sufficiently to reverse the flow in the outlet, which then became a feeder to the pond, and in time of great floods the water in the river has been known to pass through the pond, overflow a swamp,

situated between the pond and Beaver Dam brook, and find its way to Lake Cochituate. It was evident, therefore, that by building a dam of moderate height in the river, below the pond outlet, and by cutting a ditch or water course through the swamp, the river would at all seasons be made to discharge into the lake.

The dam was built at a point a few hundred feet below the bridge of the Boston and Clinton Railroad. It is constructed entirely of wood. The overfall is about 120 feet in length, with a flume 20 feet wide at its north end. The body of the dam, above the foundation, consists of strong frames, set 6 feet apart across the river, with the spaces between filled with stop planks, 4 inches thick. This part is 8 feet high, but can readily be lowered $2\frac{1}{2}$ feet by the removal of the upper stop planks.

The width of the river at this part of its course rarely exceeds 60 feet, but at times the water overflows its banks from 2 to 4 feet in depth, and the rate of flow is increased to 2,000 cubic feet per second and upwards. It was in view of this fact that the great length of the dam and its somewhat peculiar construction was decided upon.

The bed of the river is composed of a layer of gravel and sand from 2 to 3 feet thick, underlaid by a deep stratum of fine sand. The building of a dam on such a foundation is always attended with more or less risk, but a location where the conditions in this respect were more favorable was not discovered.

In preparing the foundation, precaution was taken to prevent the water from reaching the underlying sand. The bed of the river was covered with a floor of closely laid planks, for a width up and down stream of about 30 feet, and three rows of sheet piling were driven to as great a depth as practicable. The tendency to wash was further guarded against by filling earth on the up-stream side, extending some distance along the river bottom. The usual practice of holding wooden dams in place by loading them with stones and earth can only be partly secured in the design, and the deficiency of holding power was made good by three rows of round piles, driven from 10 to 12 feet into the bed of the river, to which the plank flooring and upright frames were securely fastened.

The swamp already alluded to, on the south side of the pond, consists of a thick bed of peat and muck, varying in depth from a few feet in thickness at the edges to about 40 feet at the centre, covered with a dense growth of bushes, cedars, and other trees.

The water-course was cut through the swamp for a distance of about 2,000 feet. It varies from 5 to 9 feet in depth, and is 9 feet wide, with closely planked sides and braces across the top. It starts from Farm pond at a point in the western shore, a short distance north of the Boston

and Albany Railroad; thence it runs along the shore of the pond to the railroad, passing through the embankment of the railroad in a wooden flume, provided with stop planks to regulate and control the flow. After passing through the swamp, the ditch leads across the Milford road and the Milford Railroad. Here an old ditch was reached which leads to Beaver Dam brook. The ditch and brook were widened and several culverts in its course to the lake rebuilt.

These temporary works were pushed rapidly, and were so far completed on June 19th, 1872, as to allow of their being used to reinforce the Cochituate supply. On that day water was let into the ditch to draw down the level of Farm pond, and was run each night until June 25th. On this day water from the river was turned into the pond and thence into the lake. The flow was uninterrupted until Aug. 7th, when it was stopped to finish the side planking of the ditch. Aug. 16th communication was again opened and kept open until Sept. 17th, when the ditch was closed for the season. 1,676,600,000 gallons, or 110 days' supply for the city, passed into the lake from the river. When this water was first diverted the lake stood 6 feet $\frac{1}{2}$ inch above the bottom of the aqueduct, and when the supply from the river was shut off the water had risen to 10 feet 1 inch.

July 5th. Mr. John F. Kennard authorized to build a telegraph line to Chestnut Hill reservoir for \$1,300.

July 18th. The Board were requested by the Council to lay pipes in the Fort Hill District.

COCHITUATE WATER FOR EAST BOSTON.

On July 23d the Mayor approved an order requesting the Water Board to furnish Cochituate water to East Boston. This order was adopted in consequence of serious complaints from the citizens of the quality of the Mystic water.

September 9th, the Board sent a communication to the Council (see City Document No. 89), reviewing the question at length. They call attention to the fact that one of the terms of the contract with the city of Charlestown was that the contract should remain in force until the water debt of Charlestown is extinguished; that the substitution of Cochituate would render the city liable to damages. That they had caused the pipes to be flushed out and the reservoirs cleaned, to the manifest improvement of the water. In addition to these reasons, they urged the inability to supply the Cochituate without straining the conduit.

In the Appendix to this report will be found a number of interesting letters and analyses bearing on the subject.

The Cochituate water was not let on to East Boston until after the annexation of Charlestown to Boston. (See later.)

August 15th. The hour of meeting of the Board was changed from 4 P. M. to 12 M.

September 5th. Mr. Galloupe permitted to occupy the area under the sidewalk at the corner of State and New Devonshire streets, on condition that he will relinquish the same whenever required to do so by the city of Boston.

The same day, it was voted by the Board that the Boston & Albany Railroad Co. be allowed to change the curve in their track, as stated in their communication, on condition that they excavate as many cubic feet below high-water mark as they displace, the compensation to be made to the city to be determined by N. J. Bradlee, Esq., as referee.

September 20th. A communication was sent by the Board to the Committee on the new court house, in answer to their letter, stating that a connection having been made with the Mystic works, it was now safe to abandon the Beacon Hill reservoir.

During August and September, the East Boston and South Boston reservoirs were cleaned out.

In October, twenty stone drinking-troughs were contracted for.

1873.

January 2d. The Water Board voted: That in all cases where water-pipes are allowed within any building for fire purposes, they shall be introduced into the building independent of any other supply, and at the expense of the applicant, under the direction of this Board; and no connection shall be made to it for the supply of water for any other purpose than for extinguishing fires, under the penalty of having the water shut off from said pipe and building.

Voted, That parties be allowed to use hand hose upon payment of the usual rates, subject, however, to whatever restrictions may be imposed by this Board.

The following letters were received by the Board, in relation to establishing hydrants to be supplied by the Jamaica Pond Aqueduct Co.:—

“JAMAICA POND AQ. CO., Jan. 25, 1873.

“JOHN A. HAVEN, ESQ.:—

“DEAR SIR,— In reply to your request under date of Jan. 22, 1873, I transmit a vote of our Corporation.

Respectfully yours,

“ARTHUR W. AUSTIN,

“President of said Corporation.

"At a meeting of the Jamaica Pond Aq. Co., —

"*Voted*, That the Cochituate Water Board be authorized to place hydrants on what is termed the Ruggles st. District, whenever they may think it expedient, the Board paying the expenses thereof, and acting in concurrence with Mr. Chas. Stanwood, the Superintendent of this Corporation.

"A true copy.

"Attest:

ARTHUR W. AUSTIN, *President*.

"BOSTON, 48 STATE STREET, Feb. 4, 1873.

"HON. JOHN A. HAVEN:—

"DEAR SIR, — Your favor, dated Jan. 31st, was received this morning. We understand the water taken from the proposed hydrants is to be taken for extinguishing fires. The Jamaica Pond Aq. Co. does not expect any compensation for the use of water taken for such purposes.

"Very respectfully yours,

ARTHUR W. AUSTIN,

"*President Jamaica Pond Aq. Co.*"

Jan. 23d. Alderman Leonard R. Cutter and Councilmen Wm. G. Thacher and Edward P. Wilbur were elected members of the Board for the municipal year

Feb. 6th. The President appointed Mr. Wilbur on Committee on Eastern Division, in place of Mr. Hersey, and on Chestnut Hill reservoir in place of Mr. Noyes, and Mr. Thacher on the Committee on Western Division, in place of Mr. Noyes, and on the Water Registrar's department in place of Mr. Hersey.

The Committee on Western Division reported "that Mr. Stanwood having expressed a desire to resign his position as Superintendent of the Western Division, they had considered the matter, and had decided that Mr. FitzGerald, now in the employ of the B. & A. R.R. Co. as civil engineer, was the most suitable person for the position.

Voted, That Mr. FitzGerald be appointed Assistant Superintendent of the Western Division, with a salary of two thousand dollars per annum while he remains Assistant Superintendent, and three thousand per annum when he shall be elected Superintendent."

Feb. 13th. Mr. William F. Davis re-elected Water Register by the City Council.

On Feb. 20th it was voted by the Board to repipe the whole of the burnt district.

See further on, under head of "Supply of water for fire purposes."

March 14th. A contract was made with the Boston Machine Co. for 75 Lowry Hydrants.

On March 20th the Board gave a hearing to the petition of N. Berry and others, to supply East Boston with Flax-pond water. It was afterwards voted inexpedient to take any action in the matter.

April 12. The President reported that a contract had been made with the Gloucester Iron Works, of New Jersey, for the following amounts of pipe:—

475 tons 12-inch pipe,	\$63 39 per ton.
190 " 8 " "	67 20 " "
950 " 6 " "	67 20 " "
85 " spl. castings,	109 20 " "

May 1st. Messrs. Chas. R. M'Lean and Thomas Gogin elected by the City Council members of the Board for two years from the first Monday in May.

May 5th. The Board was called to organize.

The following officers were elected:—

President,	. . .	JOHN A. HAVEN.
Supt. Eastern Division,	E. R. JONES.	
" Western "	A. STANWOOD.	
Clerk,	. . .	J. A. WIGGIN.

The resignation of Mr. S. N. Dyer as Clerk was received and accepted.

May 6th. The following committees were appointed:—

Eastern Division. — Messrs. WHITE, WILBUR, and GOGIN.
 Western Division. — Messrs. M'LEAN, CUTTER, and THACHER.
 Water Reg'rs Department. — Messrs. GOGIN, THACHER, and WILBUR.
 New Supply. — PRESIDENT and Messrs. WHITE and M'LEAN.
 Chestnut Hill Reservoir. — Messrs. CUTTER, WILBUR, and HAVEN.

The Board made their annual report in May. (See City Doc. No. 103, 1873.)

They refer to preparation for beginning work on the "New Supply."

The laying of 94,046 feet of main pipe.

" " " 2,195 " service pipes.

The completion of the high service to South Boston.

The beginning of laying pipes in the burnt district.

The City Engineer, Mr. J. P. Davis, makes a report on the distributing system in which he recommends the laying of a high-service main to South Boston, and other changes in the mains supplying the city proper.

The making of sectional plans on a large scale showing the pipe distribution.

A report on the high service, which will be found later in *Part Third*.

Mr. E. R. Jones reports the successful lowering of the mains on Bradley's Hill, Brookline, early in 1872, to an average depth of 3 feet. The whole length of pipes lowered was 2,348 feet. They were 40, 36 and 30

inches in diameter. The necessity of lowering these lines was the cutting down of the hill by the town.

The completion in August of a connection with the Mystic Works.

The cleaning of the East Boston and South Boston reservoirs in August and September.

He reports great waste of water at the fire reservoirs supplied by 4-inch pipes from the mains, and with 8-inch overflows into the sewers.

He recommends the leasing of a building for workmen in case of breaks.

Mr. Stanwood reports that arrangements had been made for cleaning out Brookline reservoir in November, 1872, but when the fire of Nov. 9th occurred it was thought best to fill the basin again at once and connect it with the supply, which was done before the cleaning was accomplished.

May 29th. The Board made an examination of some coated and uncoated pipes for the purpose of determining the practical benefit secured by the coating of the interior. The pipes under Dover-st. bridge were selected. A man was sent into the coated pipe, who reported that the tubercles averaged about twenty to the foot, were about half the size of an English walnut, and very evenly distributed. They were easily removed, and left a clean surface under them. They appeared to be more numerous at the joints than elsewhere. There was no apparent deterioration in the body of the pipe, and the tubercles were not sufficiently numerous to interfere with the flow of water.

On examination of an uncoated pipe, laid at the same time and in the same line, the interior surface was found entirely covered with tubercles, showing a great diminution of the interior diameter, which would seriously interrupt the flow of water.

The Board were fully convinced of the benefit of coating the interior of cast-iron water pipes.*

June 5th. The Special Committee on Chestnut Hill reservoir abolished.

The salary of the Assistant Superintendent of the Eastern Division increased to \$2,000. The Board

Voted, That the Superintendents of either Division shall not be allowed to contract any bill against the city for any sum exceeding one hundred dollars, unless furnished with a requisition by the chairman of his committee, excepting in case of emergency, when he is to notify his chairman of the fact immediately.

* This line was laid in 1858. The pipes were of Scotch manufacture. (See Mr. Bradlee's History, p. 183.)

July 3d, Mr. Desmond FitzGerald elected Superintendent of the Western Division, in place of Mr. Albert Stanwood, resigned.

Mr. Joseph P. Davis was elected Engineer of the Board.

A contract was made for 1,000 tons of pipe, at \$60.

July 12th. Contract made with Boston Machine Co. for hydraulic sluice-gates for Chestnut Hill Reservoir, for the sum of \$4,000. (See description of Chestnut Hill reservoir.)

EXAMINATIONS BY MR. JOSEPH WHITNEY FOR LEAKS.

The following extract is taken from the City Engineer's report. (City Doc. No. 20, 1874) :—

"On July 20 observations were made at the Beacon Hill reservoir, to determine the rate of night consumption, or, more properly speaking, the rate of *waste*, in a certain district of the city.

"This district comprises what is called the west end, north end and burnt district, and contains not far from 80,000 inhabitants. In it are located many of the manufacturing houses, principal hotels, newspaper offices, printing-houses, etc., of the city; but at the time selected for the experiment, between twelve and three o'clock, Sunday morning, the legitimate use of water must have been very small.

"This section was shut off from all communication with the Brookline and Chestnut Hill reservoirs, by gates on Bedford, Washington, Tremont, Charles, and other streets, and fed exclusively from the Beacon Hill reservoir. The leakage through the gates, if any, must have been inappreciable, as the pressures on opposite sides could have differed but slightly.

"Observations were commenced at midnight, and readings of the gauge taken every fifteen minutes. At the first of the experiment the consumption was found to be somewhat irregular, but between one and three o'clock it was remarkably uniform, showing that the draft was not due to irregular opening and shutting of cocks, but to a continuous flow at almost unvarying outlets.

"There were drawn from the reservoir during these two hours, 386,857 gallons, equal to a rate of 4,642,284 gallons in 24 hours. This enormous rate of night consumption indicated either a heavy leakage or great waste. A party of inspectors was at once organized, under the direction of Mr. Joseph Whitney, of Cambridge, who, from experience gained in searching for leaks on the Cambridge works, was particularly qualified for this work, and a careful inspection of all the fittings in the district was made, and the street mains were tested for leaks in various ways.

No leaks were discovered in the mains, but many hundreds of defective fittings were found and repaired, and some leaks in the house service pipes detected and stopped. Before the examination was concluded, however, it became manifest that much the greater portion of the night consumption was caused by waste, that is, by flow through fittings left open either carelessly or wilfully. All the leaks that could be discovered having been stopped, a second observation was made on Sunday morning, October 5, between the hours of twelve and three, as before. The water in the reservoir at the commencement of the trial stood at the same height as on the morning of July 20th.

"There was a slight wind blowing at the time of the latter trial, which caused an oscillation in the gauge-tube, and the readings were not so satisfactory as those of July. During the three hours of observation the water fell 2 feet 4½ inches, showing a consumption of 506,182 gallons, which is at the rate of 4,049,456 gallons in 24 hours. The consumption between one and three o'clock was 336,294 gallons, or at the rate of 4,035,528 gallons in 24 hours, showing a small saving, about 13 per cent. caused by the repairs made. The greater portion of the remainder of the consumption must have been caused by waste."

That everything to stop waste within the power of the Board to do might be done, the inspection from house to house was continued throughout nearly the whole city. Mr. Whitney, in his final report of Dec. 1st, says, "The work has proceeded without interruption until the present time (the number of inspectors employed averaging about 6), and the entire city has been canvassed, with the exception of East Boston, part of the Highland District, and a part of Dorchester.

"The result of the investigation to the first day of December has been the discovery of 4,111 leaks, as follows:—

- 347 bursted service-pipes.
- 491 ball-cocks.
- 1,173 hopper-cocks.
- 1,754 taps.
- 169 water-closets.
- 50 stop and waste-cocks.
- 127 hydrants.

"At the time when these leaks were discovered a notice was left on the premises, requiring that the same should be repaired within three days, and, with very few exceptions, the repairs have been promptly made."

Although a considerable saving must have resulted from the stoppage of so many leaks, yet the quantity so saved was so small in comparison to the immense waste, through fittings left open wilfully or carelessly, that it proved of no appreciable value in diminishing the daily consumption.

SUPPLY OF WATER FOR FIRE PURPOSES.

The great fire of November, 1872, had awakened a great interest in all matters connected with the extinguishment of fires, among them the capacities of the water mains. A liberal plan for the repiping of "The Burnt District" had been adopted by the Board in February (see ante), chiefly to provide a sufficient amount of water for the new Lowry hydrants.

Fire Reservoirs.

June 17th the Mayor approved the following order: —

Ordered, That the Water Board consider the expediency, and report the cost, of building fire reservoirs at the intersection of streets, under the sidewalks, to contain about two thousand gallons each, the same to connect with a 4-inch pipe from the street main. The matter was referred to the City Engineer, and on June 30th he made the following report: —

"The cost of reservoirs for the purpose and of the capacity above given would vary between wide limits, depending upon various circumstances, such as, whether or not the space under the sidewalk is used for store areas, the width of sidewalk, the size of main pipe in the street, location and depth of sewer, etc. I estimate that \$385 each, including cost of connection with street pipe and sewer, stopcocks and covers, is a fair average price for building such reservoirs within the limits of the old city.

"As relating to the expediency of their construction the following advantages and objections connected with their use may be stated: —

"They possess the advantages, —

"1st. Of allowing the concentration of a number of engines at one point.

"2d. Of permitting the engines to get quickly at work, *provided* they have a sufficient pressure of steam.

"3d. Of furnishing a supply to any engine, whatever may be its size of couplings.

(This is of importance, particularly when out-of-town engines are called into service.)

"4th. Of being more quickly accessible in times of deep snow than hydrants placed in the street.

"5th. Of holding a quantity of water in store to compensate, partially at least, for want of capacity in the street mains to deliver an adequate supply.

"While it is true that two thousand gallons would supply an engine under full steam for four or five minutes only, yet if a partial supply were being received at the time the engine is working, it would permit the latter to run uninterruptedly at its

greatest velocity for say ten or twenty minutes; whereas, in using a hydrant, the speed of the engine, and consequently its efficiency, in case the supply is not adequate, depends upon the rate of flow from the hydrant. This condition might be of considerable importance when a large number of engines are at work within a limited area, where the pipes are of small capacity.

"The objections are:—

"1st. The occupation of valuable space, more especially in the business portion of the city.

"2d. The possible waste of water into the sewers, at times when waste would be seriously felt, by carelessness in regulating the flow with the stopcock.

"3d. The great liability to cause damage to cellars, and goods stored in them, by leakage and overflow.

"4th. Not permitting the playing of a stream until the engine gets up steam.

"5th. Cost.

"For general use I am of opinion that the Lowry hydrant is preferable, but should regard the use of reservoirs in certain locations, viz., in the high-service districts, and at points in the low-service territory where the pipes are of small calibre, as judicious. The connection with the street main should be made with a 6-inch pipe, although the cost will be thereby somewhat increased.

"Respectfully submitted,

"JOS. P. DAVIS,

"*City Engineer.*"

This report was submitted to the Council on July 7th with one from the Board. (See City Doc. No. 92.)

On June 17th the Mayor approved an order requesting the Water Board to consider and report what changes were necessary to the pipe system to afford an adequate supply of water for all necessary purposes.

This order will be found in the report which we print in full, the changes therein recommended being among the most important ever made to the Cochituate works.

[City Doc. No. 112.]

"REPORT OF COCHITUATE WATER BOARD ON SUPPLY OF WATER FOR
EXTINGUISHMENT OF FIRES.

"OFFICE OF THE COCHITUATE WATER BOARD,
CITY HALL, September 12, 1873.

"TO THE CITY COUNCIL OF BOSTON:—

"By the direction of this Board, I enclose the report and plans submitted by Mr. J. P. Davis, City Engineer, to whom was referred certain questions regarding needed changes and additions to the present system of water-pipes, detailed, in an order of the Board of Aldermen, to this Board June 16, 1873.

"The 'adequate supply of water for all necessary purposes,' referred to in the order, doubtless refers to an adequate supply of water to meet such conflagrations as occurred in November last; as the present system of supply is ample for all domestic and manufacturing purposes, while in addition it furnishes a better supply for fire purposes than is possessed by any other large city in this country.

"While the supply for fire purposes is so large and generous, still it will be wise, perhaps, to incur a reasonable amount of expenditure to further increase it, so that no just cavil or criticism can be made as to the action of the City Government, or its agents having the matter more particularly in charge.

"With this view, this Board concurs in the additions and changes which are more particularly recommended by the City Engineer, which he estimates will cost some \$389,000.

"The additional improvements, costing some \$384,000, *suggested* in the report, 'to further augment the capacity of the general system,' in the opinion of this Board may be safely left to a future day, as those *recommended* by the City Engineer, and mostly determined upon by this Board, seem to meet all the reasonable requirements of the present time.

"The changes and improvements which have been and are now being made, will probably exhaust the appropriations for the current fiscal year, and to the end that no valuable time may be lost in forwarding the needed work, this Board recommend a special appropriation of \$250,000, to be expended for the purchase of pipes and other material, and the furtherance of such needed work as may be done before the cold weather closes in this fall.

"The annual appropriations for this department have usually been made so late in spring months that much valuable time is lost before the pipe contracts are made and the delivery commences. If contracts were made in the autumn, the pipes could be made in the winter months, and shipped here ready for use as soon as navigation opens, and probably better terms could be made with the manufacturers.

"Some \$200,000 of the appropriation asked for will be needed for pipes and fixtures, and the balance may be judiciously used for work already determined upon, should the season remain open as late as it sometimes does.

"This communication has been withheld for some little time, from some considerations affecting the proposed substitution of salt water for fire purposes in certain sections of the city, by an independent system of pumping works. As this is a very important matter, and one requiring careful consideration, and as the Board of Aldermen has quite recently passed an order requiring a special report upon it, it will be best to wait until the question has been more carefully investigated before a definite opinion is given upon the matter.

"Whether the new pumping system is adopted or not, still the appropriation recommended by this Board is very desirable, should the City Council agree with the suggestion submitted by the City Engineer.

"For the Cochituate Water Board,

"JOHN A. HAVEN, *President.*"

"CITY ENGINEER'S OFFICE, CITY HALL,

"BOSTON, August 16th, 1873.

"JOHN A. HAVEN, Esq., *President Cochituate Water Board:*—

"SIR: The following order of the City Council was referred to me for a report, by your Board, on June 19th:—

"IN BOARD OF ALDERMEN,
June 16th, 1873.

"Ordered, That the Cochituate Water Board be requested to consider and report to the City Council, as soon as practicable, what alterations in, and additions to, the present system of water-pipes and hydrants would be required to render them of such

capacity as would afford an adequate supply of water for all necessary purposes; to include the number and kind of hydrants, size and quantity of pipes, and cost, including expense of laying the same; 1st, for the city proper; 2d, for South and East Boston; 3d, for Roxbury and Dorchester. Also what portions of the work could be completed during the present year, and whether any additional appropriation for the same would be needed.'

"Before giving the estimates of quantities and cost that have been prepared in answer to the above order, I desire to call attention to certain alterations and extensions of the existing system of distributing mains and pipes, that have already been either determined upon by your Board, or recommended to it for adoption.

"A plan for re-piping the 'burnt district' was submitted and approved early this year, and an appropriation of \$85,000, to cover the cost of the work required, has been made by the City Council.

"Since then your Board has decided to make a number of changes and additions in other parts of the pipe system, viz., to lay a 12-inch main from Tremont street, through Dover and Fifth streets, to the South Boston high-service district; to lay a 16-inch pipe the entire length of North Charles street; to lay a 12-inch pipe in Washington street, from Boylston to Summer; to connect one with another various lines of 12-inch pipes which now terminate with 'dead ends'; to replace in a number of streets and places 6 and 4-inch pipes by 8-inch, and at other points to replace 4-inch pipes by 6-inch. The estimated cost of this work is \$78,000.

"Other changes which were recommended to the Water Board, either verbally or in the May report of the City Engineer, are now under consideration. These are, to lay a 20-inch high-service main from the pumping works to Dover street, and a 16-inch main from Dover street to the Common, there to connect with the 16-inch pipe lately laid across the Common, and through Joy street to Mount Vernon; to lay a 16-inch pipe on Tremont street, from Boylston to School; to lay 12-inch pipes in the following streets: Temple Place from Tremont to Washington, Cornhill from Court to Washington, Hanover street from Court to Union, Commercial street from Prince to Fleet, Beach street from Washington to Federal, South street from Beach to Albany, Albany street from Way to Dover, Dorchester street from First to Second, First street from Dorchester to O, O street from First to Fourth, and Granite street from Second to Mount Washington avenue; to lay 8-inch pipes in Salem, Essex and other streets, and to lay 6-inch pipes at various places (as on the wharves), to replace those of 4-inch diameter. The estimated cost of this work is \$220,000.

"In addition to the above, there are changes and extensions which should be made at an early day in East Boston, Roxbury, and Dorchester, such as, to lay 12-inch pipes in Meridian and Marginal streets and in Blue Hill avenue; to extend the 24-inch low-service main from Upham's corner to Field's corner; and to lay 8-inch pipes in a number of streets. The estimated cost of this work is \$91,000.

"The total amount of the above estimates is \$474,000, from which is to be deducted the \$85,000 already appropriated. This leaves \$389,000 as the amount of a further appropriation required to cover the cost of the proposed work.

"Of this amount about \$190,000 is for new mains and extensions, which should be laid within a year or two, at the latest, to provide for the natural increase in the daily consumption of water. The 12-inch high-service main for South Boston, the cost of which is included in the above estimate, is now being laid at an expense of about \$40,000.

"The order of the City Council, in answer to which this report is made, requires that there shall be proposed such alterations in, and additions to, the present system

of water-pipes and hydrants, as will render them of capacity to afford 'an adequate supply of water for all necessary purposes.'

"The machines now in use for extinguishing fires necessitate for their supply the delivery of large volumes of water within small areas. The present tendency is, not only to increase the number of engines that are brought into action at a single fire, but also to employ more powerful ones.

"Experience shows that conflagrations of great magnitude may be caused by the burning of low buildings, or dwellings, as well as by the burning of larger and higher ones, used for business purposes.

"It therefore follows that to furnish an adequate supply for all necessary purposes, a capacity of pipes must be provided that will deliver very large volumes of water at any point of the city which is, or which may soon be, thickly built upon.

"Without fixing upon a definite quantity of water to be delivered in a given time within a given area, I have endeavored to so augment the general capacity of the pipe system, by providing new or enlarged feeders to the smaller pipes, and by cutting the latter into short lengths, that a *very liberal* supply may be delivered at all points within the range of the distributing pipes.

"The accompanying plans of Boston proper, South Boston and East Boston, and the following schedule, will show the alterations and additions proposed for this purpose.

"Schedule showing proposed alterations in, and additions to, the distributing pipe system of Roxbury and Dorchester.

"ROXBURY LOW-SERVICE.

- To lay 570 feet 12-inch pipe in Blue Hill avenue, from Stafford to Woodville square.
- To lay 2,900 feet 12-inch pipe in Putnam and Cabot streets, from Dudley to Ruggles.
- To lay 1,160 feet 8-inch pipe in Hammond park, from Tremont street to Shawmut avenue.
- To lay 550 feet 8-inch pipe in Ball street, from Washington street to Shawmut avenue.
- To lay 850 feet 8-inch pipe in Winslow street, from Dudley to Eustis.
- To lay 600 feet 8-inch pipe in Dunlow street, from Elmwood to Dudley.
- To lay 440 feet 8-inch pipe in Elmwood street, from King street to Clay.
- To lay 330 feet 8-inch pipe in Clay street, from Elmwood to Tremont.
- To lay 260 feet 8-inch pipe in Bunstead lane, from Conant street to Longwood avenue.
- To lay 630 feet 8-inch pipe in Vine street, from Mount Pleasant avenue to Dudley street.
- To lay 720 feet 8-inch pipe in Fairland street, from Mount Pleasant avenue to Moreland street.
- To lay 350 feet 8-inch pipe in Cleveland street, from Winthrop to Moreland.
- To lay 930 feet 8-inch pipe in Moreland street, from Fairland to Blue Hill avenue.
- To lay 600 feet 8-inch pipe in Alaska street, from Perrin street to Blue Hill avenue.
- To lay 260 feet 6-inch pipe in Cunard street, from Cabot to Tremont street.
- To set 6 Lowry hydrants.

"ROXBURY HIGH-SERVICE.

- To lay 1,500 feet 12-inch pipe in Highland street, from Fort avenue to Norfolk street.
- To lay 1,200 feet 12-inch pipe in St. James street, from Shawmut avenue to Warren street.

"DORCHESTER.

To lay 2,800 feet 24-inch pipe in Dorchester avenue, from Adams to Pleasant street.

To lay 1,870 feet 24 inch pipe in Pleasant street, from Dorchester avenue to Stoughton street.

To lay 1,450 feet 24-inch pipe in Stoughton street, from Pleasant street to Boston.

The estimates of quantities are as follows:—

"BOSTON PROPER.

9,260 lineal feet of 20-inch pipe.

7,180 " " " 16 " "

27,380 " " " 12 " "

32,710 " " " 8 " "

28,980 " " " 6 " "

310 Lowry hydrants.

(Part of the above 20-inch pipe intended for the Beacon Hill and South Boston high-service is to be laid in Roxbury.)

"SOUTH AND EAST BOSTON.

45,640 lineal feet of 12-inch pipe.

17,600 " " " 8 " "

10,880 " " " 6 " "

224 Lowry hydrants.

"ROXBURY AND DORCHESTER.

5,620 lineal feet of 24-inch pipe.

6,170 " " " 12 " "

7,420 " " " 8 " "

260 " " " 6 " "

6 Lowry hydrants.

The estimates of cost are as follows:—

"First.—Boston Proper.

Pipes laid, including gates and specials	\$325,249 00
Hydrants, on old and new pipes	45,290 00
House-service pipes	33,500 00
	<hr/>
	\$404,039 00

"Second.—South and East Boston.

Pipes laid, including gates and specials	\$214,520 00
Hydrants, on old and new pipes	29,580 00
House-service pipes	23,900 00
	<hr/>
	\$268,000 00

"Third.—Roxbury and Dorchester.

Pipes laid, including gates and specials	86,000 00
Hydrants on new pipes	600 00
House service-pipes	4,500 00
Rock excavation	10,000 00
	<hr/>
	\$101,100 00
	<hr/>
Total amount of estimates	\$773,139 00

"In the above estimate, the cost of that part of the work classed under the head of extensions is \$228,000.

"It will be seen that the cost is great, and the question arises whether the advantages to be gained from the changes suggested will warrant the expenditure of so large a sum.

"The system, as thus modified, would give no greater capacity than, in view of the very large supply of water now demanded for fire purposes, most engineers would provide for a city where the distributing pipes are not already laid.

"If, however, the existing system of this city be modified by the laying of new mains and pipes, as already recommended to your Board, it will furnish a very generous supply for all purposes.

"Respectfully submitted,

"JOS. P. DAVIS, *City Engineer.*"

The result of this report was an appropriation, approved Nov. 22d, for \$200,000 for pipes.

Sept. 15th. The following order passed the Board of Aldermen : —

Ordered, That the Cochituate Water Board be directed to notify, in writing, the Superintendent of Streets and the Superintendent of Sewers before proceeding to open any street or way in the city of Boston for the purpose of laying water-pipes therein.

At the same time the Superintendent of Sewers and the Superintendent of Streets were ordered to notify the Board of intention to open streets.

Sept. 18th. The Board voted it to be for the interest of the city to retain Mr. Stanwood, and both his and Mr. Jones' salary were fixed at \$3,500.

WATER ELEVATORS.

On Oct. 6th the Water Board gave a hearing in regard to the subject of Water Elevators, and on Oct. 9th the following votes were passed : —

First. That hereafter no water shall be furnished to any hydraulic elevator, the cylinder of which shall exceed 7 inches in diameter.

Second. That an independent indicator or register for determining the quantity of water used in each case, shall be attached to each cylinder (to be approved by the Water Registrar), and that the price for the water used for elevating purposes shall be at the rate of ten cents * per hundred gallons.

Third. The Board to reserve the right, whenever it shall be deemed necessary, in order to keep up the supply of water for domestic purposes, to stop the supply granted for elevating purposes upon giving twenty-four hours' notice.

* Reconsidered on the opinion of the City Solicitor that the Board had no authority to ask more than three cents per hundred gallons for water used through meters.

Fourth. In all cases when the water may hereafter be required for elevating purposes, applications shall be made, in writing, to the Cochituate Water Board.

Oct. 11th the following order was approved :—

Ordered, That the Water Board be requested to consider the expediency and report the cost of supplying the territory bounded by Eliot and Tremont streets, Tremont row, Sudbury, Charlestown and Commercial streets, Atlantic avenue, Broad, Federal and Kneeland streets, to point of beginning, with salt water, on the Holly system, for fire and sanitary purposes.

And on Oct. 14th the following order was approved :—

Ordered, That the Cochituate Water Board consider and report upon the expediency of introducing the Holly system of water supply and fire prevention, in whole or in part, and that said Board also report upon the merits of said system as compared with other systems.

On the 18th the Board appointed a committee to consider the above matter, which was investigated, but no report made.

Oct. 16th. D. N. Skillings' petition for main pipe in Western avenue granted, provided he pay the expense of raising the same whenever the street may be raised to grade.

Nov. 19th and 20th. A thorough examination of the interior of the aqueduct was made.

"A number of new and dangerous cracks were discovered; those on the embankment to the west of Charles river were of such alarming character that it was considered imperative they should be repaired at once; accordingly the water was kept shut off and a force of masons kept at work night and day until temporary security was ensured.

"At this point there was found a crack in the bottom varying in width from $\frac{1}{2}$ to $1\frac{1}{2}$ inch and 200 feet long, through which an iron rod readily passed and penetrated the gravel filling below. The leakage here must have been considerable, but it did not make its appearance at the surface of the bank, owing to the very porous nature of the material forming it.

"The repairs made in no way add to the strength of the conduit; the best that could be done was to stop the leakage and thus remove for a while the danger of undermining the masonry."

Nov. 25th. 400 feet of flume ordered to be stored for use on the aqueduct in case of a break. This flume was procured and is stored in a building at Chestnut Hill reservoir.

Dec. 4th, it was voted by the Board that no superintendent shall be absent from his place of duty, without special permission from the President and the chairman of the committee on his division.

Dec. 24th. A contract made with R. D. Wood & Co., for 2,240 tons of pipe, at \$51.

1874.

WATER BOARD MAY PROHIBIT USE OF HAND HOSE.

Jan. 7th. The City Solicitor gave the following opinion :—

"The Water Board may, if they think it necessary to keep up a supply of water for domestic use, decline to authorize the use of hand hose, and prohibit the use thereof."

Jan. 19th. Alderman Leonard R. Cutter and Councilmen Edward P. Wilbur and W. G. Thacher were elected for the municipal year to the Water Board.

Feb. 5th. Mr. Wm. F. Davis was re-elected Water Registrar by the Council.

April 13th. The conduit was examined, and a new float gauge introduced in the gate-house at the lake.

May 4th. Mr. John A. Haven was re-elected President of the Water Board.*

May 15th. \$323 paid the Mount Warren Aqueduct Company for pipe trenches belonging to that company used by the Board.

Isaac Hayden was paid \$2,750 for land on Fisher avenue, and the right to lay pipes.

In May the Board made their annual report. (See City Document, No. 55.)

The reasons for providing "an adequate supply of pure water for the next fifty years," are urged at some length.

They report that for the first time the water works have earned a profit upon the entire cost of construction.

Twenty-four and a half miles of main pipe laid during the year.

"During the past year a large number of stand-pipes, from three to six inches in diameter, connected directly with the street mains, have been put into manufactories, warehouses, hotels, and other large and high buildings. These pipes are used for fire purposes only, being independent of the ordinary supply."

"The town of Natick has obtained an act to take water for a domestic supply from Dug pond, and has recently decided to build works for elevating and distributing it."

Conduit repaired at Newton Lower Falls.

* Messrs. Haven and White holding over under city ordinance, no election having taken place.

Material for about 500 feet of wooden flume has been bought and fitted, and is stored at Chestnut hill, to be used in case of accident to the conduit.

New float gauges have been located on the line of the aqueduct.

Important changes have been made in the system of distribution.

The completion of re-piping the "burnt district" with 12 and 8-inch pipes instead of 6-inch.

The lowering of a new siphon at the Dover-street draw.

The Water Registrar urges additional ordinances to prevent waste, and a revision of the water tariff.

An interesting report on the prevention of waste of water in Liverpool, England, printed from a manuscript report, will be found in the Appendix.

The Superintendent of the Eastern Division reports a large amount of work done in connection with pipe-laying, the building of a new blacksmith shop at the Albany-street yard, and the introduction of a new 20-horse power engine, and additional machinery for the manufacture of stop-cocks at the Federal-street works.

May 21st. The use of hand hose, which had been prohibited, was restored.

Mr. J. A. Wiggin, Clerk of the Board, having resigned his office, the Board passed the following vote:—

Voted, That the thanks of this Board be presented to the Clerk, J. A. Wiggin, for the able manner in which his duties have been performed, and that he has their best wishes for his health and prosperity wherever he may be in the future.

The above vote was ordered to be engrossed by some expert penman, and signed by the members of the Board.

May 27th. A vote of thanks was passed to the Fisher family for their generosity in allowing the pipes to be laid in Fisher avenue without compensation.

June 1st. The Mayor approved a vote authorizing the sale of a piece of land adjoining the reservoir station, Chestnut Hill reservoir, to Mr. F. Hunnewell. There was a condition in the deed that a street fifty feet wide be laid out and forever maintained.

June 30th. An order was approved directing the Board to communicate to the Council what action is desirable on the part of the Council to prevent waste of water. This vote resulted in a report of the Board, made to the Council Sept. 17, in which they state,—“We can see no way, with the present powers of the Board, by which any considerable amount of waste can be stopped. We believe, if the powers of the

Water Board were extended so that they could in a measure control the fixtures, and discriminate in the rates for the various uses, that a great saving could be made." (See City Document No. 80.)

July 9th. Mr. Walter E. Swan was elected clerk of the Board, and Mr. Charles H. Baldwin shutting-off clerk.

On Oct. 15th, the Board leased a house in Waverly place, for certain workmen on the Eastern Division, where they can be found conveniently in case of accidents during the night, or on Sundays.

The same day the following vote was passed :—

Voted, That no Chairman of any Committee shall sign a requisition for any new work without the consent of the Board.

On Oct. 22d the City Council referred the following communication from the Committee on Sewers to the Water Board. (City Doc. No. 89.)

"TO THE BOARD OF ALDERMEN:—The Committee on Sewers desire to call the attention of the Board to the great distress and danger to health in certain parts of the city, caused by furnishing a copious supply of Cochituate water, before any provision can be made for its removal by sewerage.

"The soil around our suburban dwellings, which will easily absorb the sewage of the household when the water used is pumped from wells, is rapidly saturated and overflowed when the supply comes from the water-pipes; the wells are spoiled, and the neighborhood becomes unhealthy.

"The larger part of the work of the Sewer Department has been and will continue to be in the outlying wards, following the laying of water-pipes at a greater or less interval; but it is impossible to furnish sewerage as fast as water supply, because the drainage of a small area in a high situation may require a long and expensive sewer; and this, under our law of assessment, is paid for by an almost insupportable tax upon all the estates along its line which really have no need for it. From some petitions on the files of the department it would appear that greater discomfort has arisen from a supply of water without means of drainage, than would have been encountered by keeping the original supply from wells.

"But, more than this, owing to the extended area and peculiar topography of our city, there are localities to which it will be physically impossible to extend sewers for many years; and by furnishing indiscriminately a supply of Cochituate, a permanent evil will result from a temporary convenience. To this contingency we deem it proper, through you, to call the attention of the Water Board, the Board of Health, and the citizens of the suburban wards.

"JAMES POWER,
ALANSON BIGELOW,
THOS. B. HARRIS,

"Committee on Sewers."

The City Solicitor, on being consulted in regard to this matter, gave it as his opinion that if it is the rule of the Water Board to lay main pipes whenever it pays 6 per cent., then the Board is obliged to give every citizen water when it will pay the required 6 per cent. (See vote of the Board.)

No action was taken.

Sept. 8th. The largest break in main pipes since the introduction of water occurred. (See Mr. E. R. Jones' report, City Doc. No. 88, 1875.) It was on the 40-inch line on Brookline avenue. The pipe rested on the stone capping of a culvert, and the weight of five feet of additional filling put on the street caused one length of pipe to break its entire length. No great damage was done, as the water flowed into a creek close at hand.

October 29th. The Board received a communication from the Joint Standing Committee on Water, of the Council, requesting the Board to use all means in their power to prevent the unnecessary use of water.

The same day the Board passed the following vote:—

Voted, Under the present scarcity of water, no application for water for motive-power be granted.

The following notice was sent to water-takers:—

"On account of the extreme dry weather during the past two months, and the consequent low state of water at the lake (which is falling at the rate of one inch per day), all consumers are cautioned against waste, and to observe the strictest economy in its use. Unless we are favored with copious rains this fall, it will require the most rigid economy to keep up the supply through the winter. Arrangements are now being made for pumping from the lake into the conduit, as the necessary authority has not been granted this Board for taking a supply by means of the connection made with Sudbury river ten years since."

November 2d a break occurred in the 20-inch pipe opposite Chickering's factory, on Tremont street. The Board were attending an exhibition of the working of the high-service pumps at the time.

(See Mr. Jones's report, City Document No. 88, 1875.)

On November 3d, an ordinance was passed by the City Council enlarging the powers of the Board over fixtures, and making certain amendments to the rates. [See *Part Fourth*.]

Its object was to prevent waste and improper use of water.

HOPPER-CLOSETS.

In accordance with the provisions of the ordinance above referred to, the Water Board, on November 11th, directed the Water Registrar "to charge from the first day of January next, all plain hopper-closets, wherever located within the premises of water-takers, at the rate of ten dollars each, unless such closets are operated by automatic or self-closing faucets, in which case the charge for said closets to remain at the old tariff

of prices. Also, that all urinals, when not operated by automatic or self-closing faucets, shall be charged at the rate of five dollars each. Also, that the charge for hand hose be continued at the old scale of prices, viz. : five and ten dollars each, except in cases where the premises contain more than 10,000 feet of land, in which case the Water Registrar be authorized, with the approval of the committee on his department, to charge according to the quantity of water likely to be used."

November 17th. The Board sent a communication to the Council asking for a further appropriation.

We extract the following : —

" . . . The calls upon this department, in consequence of the large fires of November and May last, have been exceptionally urgent. A better supply of water for the extinguishment of fires has been the demand of the City Government and the public. This 'better supply' of necessity includes the laying of larger pipes in certain districts. The putting in new hydrants, and a somewhat radical change in the distributing system from that which was adopted something over a quarter of a century ago. All these improvements entail large expense ; but this Board has not hesitated to meet the demand in a liberal spirit.

" . . . Nearly \$100,000 has been expended since May last for works not included in estimate, etc.

"The effect has been increase of head in low service."

On January 2d, 1875, an order was approved appropriating \$100,000 for the ordinary work of the department.

FLAX POND.

November 21st. The following order of the City Council was approved : "*Ordered*, That the City Engineer be directed to make such surveys and measurements as may be necessary to ascertain the actual amount of water that can be furnished from Flax, Sluice and Cedar Ponds."

The above order grew out of an offer of the Flax Pond Water Co. to supply East Boston with water.

The following report was made December 21st. (City Document No. 110.)

"A careful survey of the water-shed of the valley has been made, and its area found to be 2.61 square miles. The area, as computed from a survey made a few years ago, for the city of Lynn, is 2.48 square miles. In the survey just completed, nearly 100 acres of doubtful territory have been included, which probably accounts for the difference of results above shown.

"It having been claimed that these ponds are largely fed from springs having their source outside the apparent water-shed, special attention was given to the discovery of their effect, if any, upon the yield of water. The levels of the neighboring water-courses and ponds were taken, and the heights of water in the intervening wells were measured; also weir measurements of the flow of water were made at the outlet of Flax pond, and at a point a little below Cedar pond.

"The data thus obtained show conclusively that there was no appreciable flow into any of the ponds from any other source than the natural water-shed.

"The natural flow at the outlet of Flax pond was found to be about 312,000 gallons in 24 hours, or about 128,400 gallons per square mile of water-shed. The same relative flow was found at the weir below Cedar pond, showing that no springs from a distant source found their way into either Flax or Sluice ponds. This flow corresponds to the flow usually found in the streams of eastern Massachusetts in seasons of drought. Thus the flow of the Sudbury in the early part of November of this year, as determined by accurate gaugings, was 135,000 gallons per square mile of water-shed.

"The yield of this valley, then, is to be computed from the area of its water-shed, and its capacity for storage. The character of the ground surface—being very steep and rocky—is such as to assure the collection of a large percentage of the rainfall; it is therefore assumed that 16 inches may be collected in the year of extreme drought, and that 20 inches may be collected in each of a series of eight years of low rainfall.

"Allowing for the effect of storage and of evaporation from water surfaces, and computing the yield under the above assumptions, it is found to be about 2,000,000 gallons in 24 hours. The ordinary average daily yield would be about 2½ millions.

"Respectfully submitted,

"JOS. P. DAVIS,

"City Engineer."

In submitting this report the committee recommended that no action be taken, and none was taken.

On Nov. 30th, Mr. Edward A. White was elected a member of the Water Board for two years, from the first Monday in May, 1874, and on Dec. 7th, Mr. L. Miles Standish was elected for the same term.

On Dec. 3d, when the pumps were started at the lake, the conduit was examined and the springs within 1,500 feet of the lake, bringing sand into the conduit, were found to have increased in volume and strength.

A set of stop planks, worked by a differential block, were arranged in the Grantville Waste Weir of the aqueduct, enabling the water to be shut off in case of a break below that point.

Dec. 17th. Mr. Thomas Gogin who had been serving as President for some time was elected President of the Board.

Voted, That the President be authorized to approve all bills to the amount of three hundred dollars, which do not properly belong to any committee.

Dec. 22d. The Fire Commissioners sent a communication to the Board recommending a change in the size of the outlets of hydrants from 2 inches to 2½ inches, which was adopted.

At a special meeting held Dec. 19th, the following committees were appointed: —

Eastern Division. — Messrs. WHITE, STANDISH and THACHER.

Western Division. — Messrs. M'LEAN, CUTTER and WILBUR.

Water Registrar's Department. — Messrs. STANDISH, THACHER and WILBUR.

New Supply. — The PRESIDENT and Messrs. M'LEAN and STANDISH.

TEMPORARY SUPPLY OF WATER, 1874-75.

While the question of a new supply of water was being debated in the Council, an alarming drought prevailed over a large portion of the country.

The dry weather began early in the fall of 1874, and continued during the succeeding winter. The Board, seeing that a scarcity of water, amounting perhaps to a water famine, was imminent, made application, Oct. 30th, to the Mystic Water Board, to ascertain whether they could furnish any water to Boston. The answer received was to the effect that they could supply 3,500,000 gallons per day, when it was voted by the Board, Nov. 5th, "to take all the water the Mystic Works could spare." A connection was made at once and the Cochituate was reinforced by an average of from two to two and one-half millions of gallons per day. The same drought which affected the Cochituate basin soon made itself felt in the Mystic valley, and the Mystic Board soon became alarmed lest they should not have water enough to supply their own districts. Accordingly the Mystic water was shut off after having furnished 57,191,258 gallons.*

In the mean time the Board made active preparations for pumping at the lake. The same machinery which had been resorted to in 1871-72 was overhauled and put in order. On Nov. 7th the Mayor signed an order authorizing the establishment of pumps, and on the 11th the Board authorized the Committee on Western Division to put them at work at the earliest practicable moment. On Dec. 3d the pumps were started, and for the next ninety days the supply to the city was kept up by pumping from the deep portions of the lake.

The pumps were stopped March 3d, 1875.

During this time the water fell with great rapidity, reaching a lower point than ever known before, viz.: $9\frac{1}{2}$ inches below the bottom of the aqueduct.

Nov. 16th, 1874. Gen. B. F. Butler sent a communication to the City Council from the Wamesit Power Co., in behalf of the other mills on the

* The price paid for this water was \$7,652.19.

Concord river, tendering to the city, during the winter, so much of the Sudbury river as its necessities might require.

Nov. 28th an order was approved authorizing the Board "to obtain the assent in writing of all parties owning rights or privileges in the waters of the Sudbury river, for the diversion of said waters into Lake Cochituate, for the use of the City of Boston during such period as may be agreed upon by the said owners and the said Water Board; and upon the assent of all the owners as aforesaid, the Cochituate Water Board is hereby authorized to divert the waters of Sudbury river into Lake Cochituate, in such manner as they may deem expedient, the expense to be charged to the appropriation for the Cochituate Water Department."

The Board, after consultation with the City Solicitor, sent an agent to the parties interested, who all declined to ratify the offer which had been made, with one exception. On Dec. 7th this information was transmitted to the Council, who passed a vote of thanks to Gen. B. F. Butler for his generous offer.

The Council having authorized the Board, Jan. 2d, 1875, to seize the water of the Sudbury river, the Board met Jan. 5th to consider what steps were necessary to keep up a temporary supply, etc. The City Engineer and City Solicitor were present in consultation. It was finally voted to authorize the Committee on New Supply to see the owners of land on the line of the temporary connection, between Farm pond and the lake, to make arrangements with them for the maintenance of the temporary works for a term of five years. On Jan. 7th this permission having been obtained, the Board voted to have the ditch cleared of ice and the Sudbury river turned into the lake.

On Jan. 21st the Mayor and members of the Water Board signed the formal taking of the Sudbury river, and on the same day the City Engineer, by authority of the Board, turned the water into the lake.

NONESUCH POND.

On Nov. 16th the Mayor signed the following order:—

"*Ordered*, That the Joint Standing Committee on Water be requested to consider the expediency of turning the water of Nonesuch pond into the Cochituate conduit, or Lake Cochituate, as a supplementary supply during the time required for the construction of the works for a permanent supply."

On Nov. 27th the following reports were submitted. (See City Doc. No. 103.)

Majority Report.

"IN COMMON COUNCIL, Nov. 27, 1874.

"The Joint Standing Committee on Water, who were requested to consider the expediency of procuring a temporary supply of water from Nonesuch pond, would respectfully recommend the passage of the accompanying order.

"For the committee,

"FREDERICK PEASE.

"*Ordered*, That His Honor the Mayor be requested to petition the General Court, at its next session, for the passage of an act authorizing the City of Boston to take water from Nonesuch pond in the towns of Weston and Natick, and to take, from time to time, such lands as may be necessary to preserve the purity of said water, and to conduct it into Lake Cochituate or into the conduit between Lake Cochituate and Chestnut-Hill reservoir."

Minority Report.

"IN COMMON COUNCIL, Nov. 27, 1874.

"The undersigned respectfully dissent from the recommendation of the majority of the committee in the matter of petitioning for authority to take the waters of Nonesuch pond, for the following reasons:—

"It appears, from the statement of the engineer, that it will require a full working year, after legislative authority is obtained, to construct a storage reservoir in connection with Nonesuch pond. The cost for land and construction is estimated at \$210,000, in addition to which must be included mill damages and claims for withholding water from Waban lake, a large ornamental pond in front of the estates of Hollis Hunnewell and others, in the town of Needham. The time required for filling the reservoir after its completion, in consequence of the small water-shed, depending upon the annual rainfall, will be from one to six years, and it would only be of value when full, and in a year of drought, like the present. There is a similar reservoir in connection with Lake Cochituate, namely, Dudley pond. This was drawn off during the drought of 1872, and with a more favorable water-shed, it has not since that time, if we are correctly informed, been filled. To construct and fill the proposed reservoir will require more time than to complete works which will furnish the city with an abundant supply of water for the next fifty years. It therefore seems, to the undersigned, undesirable to make the large expenditure required for the proposed reservoir, or any similar small scheme, unless the City Council decide to abandon the surer, better and more ample ones now under consideration. It should be borne in mind that, in addition to the large outlay which must be made during the next year for the Cochituate Water Works, nearly one million dollars will have to be provided, during the same time, to meet the cost of the proposed sewer and storage reservoirs for the Mystic Water Works. To enable the city to receive the benefit of the contracts now existing between the Mystic Works and the several municipalities depending upon that source for a water-supply, work should be commenced early in the coming year, in constructing the sewer and reservoir, so that the water may not only be pure, but ample in quantity.

"With a profound regard for the best interests of our city, and with the firm conviction that an abundant supply of pure water will tend to promote the prosperity, health and comfort of its people, we again urge upon the City Council the importance of prompt and liberal action upon the question of an additional water-supply.

"Ours is a manufacturing city, and the chief element which enters into the successful operation of manufactories is pure water for steam purposes. New industries, requir-

ing water for steam or motive power, are constantly springing up; but during the past year all such have been discouraged for want of water to supply their needs. The revenue from the Cochituate Water Department more than doubles every ten years, reaching this year upwards of one million of dollars, and, should the expenditure for the proposed Sudbury works reach the sum estimated, we are confident the increase in revenue will provide for the interest on the cost, and bring to our city the prosperity which follows the permanent establishment of manufacturing industries in any community.

“S. B. STEBBINS,
ALANSON BIGELOW.”

SUPPLY OF WARDS 17 AND 19 [WEST ROXBURY AND BRIGHTON].

The annexation of these districts was consummated Jan. 5th, 1874.

As early as April 20th, 1874, the Water Board were requested by the City Council to consider the expediency of providing a main pipe for Ward 19 [Brighton], and on May 12th another order was approved, directing the Joint Standing Committee on Water to present a plan for supplying Ward 17 [West Roxbury] with water.

On May 25th the committee reported an order for the surveys of the districts, and on June 6th the Mayor signed an order appropriating \$10,000 for this purpose.

On Aug. 6th the Water Board authorized the City Engineer to proceed with the necessary investigations.

On Nov. 23d an order was reported in the Council, on the petition of the citizens of these two wards, and on Dec. 24th the Mayor approved an order, authorizing the Water Board to make a contract for pipes.

These pipes were cast during the winter of 1874-75, and early in May, 1875, work was begun in Ward 19 by extending a pipe through Brighton avenue, to supply the low-service.

JAMAICA POND.

On Oct. 12th, 1874, a petition was received by the City Council from a number of citizens from Ward 17 asking the city to purchase Jamaica pond, and supply Ward 17 from that source.

The communication was referred to the Committee on Water, Oct. 15th, which resulted in the following report:—

Report of Committee on Water on Subject of Proposed Purchase of Jamaica Pond and of Water Supply for West Roxbury and Brighton.

“IN BOARD OF ALDERMEN, Dec. 21, 1874.

“The Joint Standing Committee on Water, to whom were referred the petitions of G. Winthrop Coffin and others, and John C. Pratt and others, of Ward 17, asking the

city to secure by purchase the property of the Jamaica-pond Aqueduct Company, for the purpose of supplying the citizens of said ward with pure water, having carefully considered the subject, would respectfully report that the petitions were referred to the City Engineer, with the request that he would consider the whole subject, and report the facts as to the value of the property and the best method of supplying the West Roxbury and Brighton districts with water. The report of the engineer is appended hereto, giving full information in regard to the matter.

"The committee are of opinion that the price asked for the property (\$200,000) is more than its real value, and therefore report that no action is necessary so far as relates to the purchase of Jamaica pond. The engineer suggests that West Roxbury and Brighton can be supplied for a few years from the Brookline Water Works, which are favorably located for that purpose. Your committee therefore recommend the passage of the accompanying order.

"For the Committee,

"S. B. STEBBINS,

"Chairman."

The order, which was adopted, will be found further on.

"APPENDIX.

"OFFICE OF CITY ENGINEER, CITY HALL, BOSTON, Dec. 21, 1874.

"ALDERMAN S. B. STEBBINS, *Chairman Joint Standing Committee on Water* :—

"SIR, — In answer to the vote of your committee, referring 'the petitions of John C. Pratt and G. Winthrop Coffin, that the city would purchase Jamaica pond, to the City Engineer, with request that he report the facts as to the value of the property in question, and the best method of supplying West Roxbury and Brighton with water,' I would respectfully submit the following :—

"Jamaica Pond.

"The property of the Jamaica-pond Aqueduct Co. consists of the rights and privileges secured by act of Legislature, Ward's pond and adjacent lands, and of the pipe-system of distribution, with its appurtenances.

"I know of no precise standard by which to estimate the value of these items.

"The works were purchased from their original owners, by Boston, in 1851, for the sum of \$45,000, the objects of the purchase being, '1st, to be rid of rival works; 2d, to quiet all claims for injury to their pipes by laying down our pipes; 3d, to annul the privilege of breaking up and injuring the streets whenever and wherever they saw fit.' In 1856 they were sold to the present owners for the sum of \$32,000 with the proviso that no water from them should be distributed within the limits of the city as laid down at that date.

"At the time these purchases were made, the value of the property consisted almost entirely of the franchise; hence they may be said, in a certain sense, to determine the value of the first item.

"The company own about six acres of land, which are valued by the assessors at \$15,700.

"It has a little over eleven and one-half miles of cast-iron pipes laid in various streets of Boston Highlands and the town of Brookline, varying in diameter from three to twelve inches. The annexed table will show the sizes and lengths of these

pipes, also the sizes and lengths of the pipes belonging to the Cochituate Works laid in the same streets.

"The estimated cost of the Jamaica-pond pipes laid, at present prices, is about \$88,000, of which sum \$20,000 is to be charged to the pipes laid in Brookline.

"Those of three and four inches diameter are of little or no value to Boston, and the same may be said of the larger sizes laid in streets in which there are pipes of the Cochituate Works. It will be seen, therefore, that the pipe-system is of very little value to this city, so far as its use in connection with the Cochituate Works is concerned.

"A yearly revenue is derived from the works, the greater portion of which is paid by water-takers living in Boston (and on streets in which the Cochituate pipes are laid). Should the city buy the works, and discontinue their use, the water-takers above mentioned would be compelled to take a supply from the Cochituate Works, and would pay a revenue to the city which now finds its way into the hands of the company. It was said the works were worth a sum of which the net revenue was the interest, and that the city would be largely benefited by their purchase for such a sum, in at once ridding herself of claims for damages to pipes, and the injury sustained by the opening of streets for repairs, etc.

"The total revenue from water-takers for the past four years has been as follows:—

1870,	\$17,417 58
1871,	16,582 96
1872,	17,817 69
1873,	16,716 47
Average for four years, \$17,021.80.	

"From this sum, about \$1,800, collected from takers in Brookline, should be deducted, as those takers will soon be provided with a supply from the Brookline works, of equal, if not superior, quality, and under a much greater head.

"In stating the cost of maintenance, I assume that, should the Jamaica-pond works be purchased, they would be thrown out of use, and the supply from them substituted by one from the Cochituate works. As we already maintain distributing pipes in most of the streets occupied by the company, the additional expense of maintenance would be due chiefly to the service-pipes; this may be roughly taken at \$1,000 per year; hence the net revenue from the Boston takers, with the Jamaica-pond rates, would be about \$14,200, which, at 7 per cent., is the interest on \$200,000.

"Mr. Charles Stanwood, Superintendent of the works, is of the opinion that, with the Cochituate rates, the revenue would be increased by at least 33 per cent. This is also stated in the paper presented by the petitioners enumerating the benefits to be derived by the city in making the purchase.

"It is suggested, in the petition, that the pond may be made of service in supplying Jamaica Plains and the higher lands of West Roxbury by means of Holly pumps, and also would serve as a reservoir for the storage within the heart of the city of the water from the Cochituate pipes, which can readily be connected with those leading from the pond.

"The natural daily yield of the pond in dry seasons has been stated to be from 200,000 to 300,000 gallons. The owners think that the present yield can be doubled by raising the dam of Ward's pond about 20 feet; but Mr. Herschel, Civil Engineer, in a report upon the supply of water for the town of Brookline, 1873, estimates the yield after the improvements shall have been made will be about 300,000 gallons in 24 hours.

"A supply upon the direct system, which is that employed by the Holly Company, requires the pumps to be operated night and day, and that the delivery from the pumps shall fluctuate with the constantly varying rate of consumption. The cost of maintenance and operating under such conditions is relatively very large, and a supply so small as that afforded by Jamaica pond will not warrant the cost of erecting and operating machinery, such as, without the aid of a high level reservoir, would be needed to meet the demands for water in times of serious fires.

"If, however, the supply for the lands in West Roxbury above grade 60 be drawn from Parker-Hill reservoir, a pump to be worked during the day hours only might be advantageously used in times of short supply to force the pond water into the main leading from the reservoir. The cost of these pumps would not be large; but the system cannot be recommended, except as a means of relief under certain emergencies, such as a short supply from Lake Cochituate within the next few years, an accident to the Highland works, or in case these latter works are overtaxed. The elevation of the pond, about 55 feet above mean high water, is not suitable for a reservoir to be used in connection with the Cochituate distributing system. The only advantages of importance to be gained by the city in the purchase of this property are:—

"1st. An increase in the water revenue.

"2d. The annulling of the rights possessed by the company to open streets, etc.

"3d. The possession of a ready means of increasing or maintaining the high-service supply in case of emergency.

"SUPPLY OF WEST ROXBURY AND BRIGHTON.

"If the Sudbury-river scheme for an additional supply be adopted, and the existing restrictions upon the use of water be kept in force for the following two or three years, a supply to Chestnut-Hill reservoir may be provided which will meet the probable wants of the city, even if the distribution shall be extended into the newly annexed towns; as, for the first year or two, the daily consumption in these towns will be but a few hundred thousand gallons,—a quantity hardly appreciable in a supply of eighteen or twenty millions.

"Those portions of West Roxbury and Brighton which can be reached from the low-service system of the Cochituate works can easily be provided for by the extension of the low-service mains.

"That portion of West Roxbury which lies above grade 60 may be conveniently supplied from Parker-Hill reservoir; as the high-service works are of sufficient capacity to maintain the supply for a few years. The higher lands of Brighton also may be supplied from this source, but very long and costly mains will be required to conduct the water, which will be of little or no value when the pumping-works and centre of the high-service distribution are moved to the neighborhood of Chestnut-Hill reservoir. (See City Doc. No. 38, 1873.)

"Both Brighton and West Roxbury can be supplied better from the Brookline works, now building, provided that a contract for a supply for a short term of years can be made with that town. (Mr. Kirby, of the Brookline Water Board, is of the opinion that such a contract can be made.)

"The reservoir of these works, being in the vicinity of Chestnut-Hill reservoir, is favorably located for this purpose. It is somewhat higher than Parker-Hill reservoir. The mains laid from it will remain in permanent use, and the supply of water to it will be ample for the necessities of the three places.

"Water will be introduced into Brookline early next season, or before a system of pipes can be laid in West Roxbury and Brighton.

"JOS. P. DAVIS, *City Engineer.*"

A table is added, showing the sizes and lengths of Jamaica-pond and Cochituate water pipes in Boston Highlands, which we omit. (See City Doc. No. 108.)

BROOKLINE.

The town of Brookline having during this time nearly completed a system of water works for that town, with Charles river as its source of supply, embracing a reservoir a few feet higher than the high-service system of Boston, the following order was approved by the Mayor:—

Ordered, That the Cochituate Water Board be authorized to confer with the Water Board of the town of Brookline and ascertain upon what terms a supply of water can be furnished to the inhabitants of Wards 17 and 19 for a term of either three or five years, and report thereon to the City Council.

Under authority of this vote the Board had several interviews with the Water Board of Brookline, and finally transmitted the terms which were offered by Brookline to the Council, May 19th, 1875. These terms were that Boston should pay Brookline eighty-five per cent. of the collections, besides other restrictions or reservations. The City Council did not see fit to accept the terms offered, and on June 1st, 1875, the Mayor approved the following order:—

Ordered, That the Cochituate Water Board be requested to devise means for supplying Wards 17 and 19 with water from the Cochituate Works.

On June 2d this order was referred by the Water Board to the Committee on Eastern Division and the City Engineer, to report. A verbal report was afterwards made by the City Engineer to the Board on this subject, which resulted in supplying Ward 17 from Parker-Hill reservoir, and Ward 19 temporarily from the 40-inch main. In the mean while the Board had voted March 22d to ask the City Council for \$100,000 for pipes for these wards, when the following order was passed:—

Ordered, That the Treasurer be and he hereby is authorized to borrow, under the direction of the Committee on Finance, one hundred thousand (\$100,000) dollars, the said sum to be added to the amount heretofore borrowed for the purpose of purchasing pipes, etc., for the supply of water in Ward 17 and 19, to be used for the same purpose and in laying down said pipes.

Approved April 30th, 1875.

SEVERE FROST OF 1874-5.

The winter of 1874-5 proved the most trying one, as far as the freezing of the pipes was concerned, since the establishment of the water works. The frost penetrated the ground to a greater depth than ever before experienced. Five feet of frost were frequently picked through in thawing out the pipes, and how much farther it went it is difficult to say, but instances were reported of frost found at depths of six feet or more. Over 13,000 feet of main pipe, some as large as twenty inches in diameter, and over 1,000 service pipes, were frozen. A large force of men were kept constantly busy thawing out the pipes, and notwithstanding every exertion on the part of the Board and the Superintendent, Mr. E. R. Jones, many consumers were without water for weeks. Fully \$20,000 was expended on this account. The original depth at which pipes were laid was four feet. This was altered in 1865 to four and a half feet, and in 1872 to five feet.

The main pipes frozen were all "dead ends."

The following table will show the lengths and sizes :—

	Feet.
20-inch, on Charlestown bridge	200
12 "	1,269
8 "	400
6 "	8,565
4 "	2,681
Total length	13,115

1875.

On January 7th, 1875, it was voted by the Board to alter the 2-inch outlets to hydrants to 2½ inches, and two 36-inch gates were authorized, at an expense not exceeding \$1,400 each.

RATES FOR HAND HOSE.

January 21st. The following rates for hand hose were adopted by the Board, subject to changes on satisfactory statement in writing of parties using the same.

	Per annum.
Premises containing 5,000 feet of land, or less,	\$5 00
Corner lots,	10 00

							Per annum.
Premises containing between 5,000 and 10,000 feet of land,							\$10 00
"	"	"	10,000	"	20,000	"	20 00
"	"	"	20,000	"	30,000	"	30 00
"	"	"	30,000	"	40,000	"	40 00
"	"	"	40,000	"	50,000	"	50 00

January 23d. A break occurred in one of the old 20-inch pipes on Dover-street bridge.

On February 4th certificates of election were received from the City Clerk announcing the election of Alderman Charles J. Prescott and Councilman Wm. G. Thacher as members of the Board for the remainder of the municipal year, and until others are elected in their stead. On the 26th of February the certificate of election of Councilman Amos L. Noyes as member of the Board was received.

On February 6th, out of five bids for water-pipes, Messrs. Starr & Son received the contract, at \$42 per ton of 2,240 pounds, \$89.60 for special castings.

The same day Alderman Charles J. Prescott was appointed on the Committee on Western Division.

February 15th. Mr. William F. Davis was re-elected Water Registrar by the City Council.

February 23d. A freshet from Snake brook broke into a manhole in the aqueduct near Cochituate. The stone covering was displaced by the lifting of the ice. No damage was done to the brick-work.

March 4th. Mr. Amos L. Noyes was appointed on Committee on Western Division, and also on the Water Registrar's Department.

On March 22d the Board voted to ask the Council for authority to locate post hydrants in such sections of the city as the Board may, in consultation with the Board of Fire Commissioners, deem expedient. This resulted in an order, approved April 6th, giving authority for the erection of hydrants in such localities as the Committee on Paving and the Superintendent of Streets shall approve.

CONSTRUCTION ACCOUNT.

April 29th. The Board decided to charge all main pipe, hydrants and gates used for extension of the works, and the cost of laying the same, to construction account.

In the Annual Report of the Board for the year ending April 30th, 1875, attention is called to the following facts: —

The loss of a season and a half on the Sudbury works by the delay of the City Council.

The purchase of water from the Mystic works, and the resort to pumping at the lake to keep up the supply.

The imperfect method of keeping the construction and expense accounts in the past, and a change so as to show the accounts more correctly.

The laying of $23\frac{1}{2}$ miles of main pipe, making a total of 285 miles and 4,016 feet since the beginning of the works.

The change of supply to East Boston.

A recommendation that South Boston and Beacon Hill reservoirs be abandoned; and that plumbers should be licensed.

The City Engineer refers to the drawing down of Dug pond to allow the town of Natick to construct their works.

The various methods devised for preventing pollution of the lake.

The completion of plans showing the whole distribution of the city.

The completion of Parker-Hill reservoir.

The "new supply" works.

The reports on Flax and Jamaica ponds.

A table of all recorded examinations of the aqueduct will be found appended to the report of the Superintendent of the Western Division.

The Superintendent of the Eastern Division, besides other important matters referred to elsewhere, reports the discontinuance of the old chamber on Tremont street, opposite Chester square, early in the spring. "Two 36-inch and two 30-inch gates of the old pattern were taken out, and one 36-inch gate of the newest pattern put in. Suitable brick boxes or chambers were made round them, and the old chamber filled up and paved over."

Mr. Thomas Gogin and Mr. Leonard R. Cutter having been elected members at large of the Water Board by the City Council, the Board was called together on May 3d, to organize.

The following officers were elected:—

President,	. . .	THOMAS GOGIN.
Clerk	. . .	WALTER E. SWAN.
Supt. Eastern Division,		EZEKIEL R. JONES.
Supt. Western Division,		DESMOND FITZGERALD.*

On May 6th, the following committees were appointed:—

Eastern Division.—Messrs. WHITE, STANDISH and THACHER.

Western Division.—Messrs. CUTTER, PRESCOTT and NOYES.

New Supply.—Messrs. GOGIN, CUTTER and STANDISH.

Water Registrar's Department.—Messrs. GOGIN, CUTTER and STANDISH.

* Elected June 15th.

May 24th. The President was authorized to approve any bill not exceeding the sum of \$300.

On May 31st Mr. Thomas Gogin resigned, and Mr. L. Miles Standish was elected President *pro tem*. June 8th.

The same day the Superintendent of Western Division was authorized to build a fence at Lake Cochituate, and establish bounds on the line of the aqueduct.

June 24th. The Board voted to employ an assistant clerk, and Mr. Joseph W. Swan was elected.

July 9th. Five horses were authorized to be purchased for the Western Division.

July 12th. Mr. Charles E. Powers was elected a member of the Water Board, by the City Council, in the place of Mr. Thomas Gogin, resigned.

August 5th. Mr. L. Miles Standish was elected President of the Board.

August 19th. The Board voted to accept the proposition of the Boston & Albany Railroad to build the pier and abutment at Cottage Farm for the pipe bridge. By a subsequent agreement between the city and the railroad, the fee in this pier and abutment was vested in the city.

August 24th. The Board voted to authorize the Superintendent Western Division to build a cast-iron weir at the lake.

This weir, 21 feet in length and cast in a single piece, was put in place during the fall, in the lower dam at the lake. Its object is to measure the water, which is wasted from the Cochituate water-shed, more accurately.

September 2d. The Board voted to allow the Board of Health to use water for flushing out cesspools attached to the sewers at the same rate as other departments, viz., 3 cents per 100 gallons.

September 30th. The Board voted "to reduce the pay of employees of the Eastern and Western Divisions, and the 'off and on department,' 10 per cent., and to pay laborers employed after October 15th \$1.50 per day."

October 18th. The Joint Standing Committee on Water of the Council reported on the recommendations of the Board in their annual report in regard to the sale of the Beacon Hill and South Boston reservoirs, and the licensing of plumbers, that it would not be safe to use the reservoirs for any other purpose than that for which they were intended, until the high-service works are removed to Chestnut Hill. They also reported an order for petitioning for an act to license plumbers, which, after being amended by the Common Council, was tabled in the Board of Aldermen.

BAD TASTE IN CHESTNUT-HILL RESERVOIR.

The following report on the above subject is taken from Mr. J. P. Davis' report to the Water Board, May 1st, 1876: —

"Early in October complaint began to be made at the office of the Water Board that the Cochituate water tasted badly and was unfit for use. The taste was variously described; some persons thought it like cucumbers, others like fish-oil, still others like dead leaves, etc., but as a rule it was spoken of as a 'cucumber taste.'

"At first the complaints came from persons living at the South-end and on the Back-bay lands; later they came from the West and North ends as well, and finally from South and East Boston. Even after the taste became very wide-spread, people living where there was little circulation of water in the pipes, as in some parts of Dorchester, reported that the water supplied to them was unusually clear and sweet.

"On October 23 the lake was visited and samples of the water were taken at various points, and at all depths, but not the slightest trace of the peculiar taste could be discovered. Samples taken where the water was shallow, and some from points near the bottom in deep water, had the earthy taste which usually accompanies pond water; but the greater portion of them were clear and tasteless.

"On October 26th the Brookline and Chestnut Hill reservoirs were visited; but the cucumber taste could not be detected in the water contained in them. Water taken in front of the screens of the efflux gate-house of the Chestnut Hill reservoir was tasteless; but a sample taken from behind them or at the mouth of the outlet pipe was found to have the cucumber taste in a slight degree.

"At that date the taste may be said to have been confined to the water in the pipes; but on the next day it was discovered in all parts of the Bradlee basin of Chestnut Hill reservoir, having spread through that large volume of 500,000,000 gallons of water in one night, apparently. During the night there was a thunder-shower, accompanied with violent winds and agitation of the water, which may have aided in developing the taste.

"The reservoir was immediately shut off from the distribution, and in a short time no taste could be detected in the water delivered in the city, indicating that the trouble originated in this reservoir, or at least showing that the conditions necessary to develop the taste existed there.

"On the night of December 3d, the gate was opened about 1 foot, and some 3 or 4 million gallons of water let into the distributing pipes; but such an exceedingly disagreeable effect was produced that the gate was closed on the following morning. At this time the Brookline reservoir was lowering rapidly, owing to the excessive night waste to prevent freezing of service-pipes.

"The taste in the Chestnut Hill reservoir gradually disappeared, and on April 1st the gate was again opened and the water let into the city, without causing any noticeable change in the water delivered to the consumers. The reservoir has been in constant service since that date.

"Prof. William R. Nichols, of the Massachusetts Institute of Technology, was requested to make thorough investigation to ascertain the cause of the trouble, that its recurrence might be prevented if possible, and he engaged Mr. Edward Burgess, Secretary of the Boston Society of Natural History, and Dr. W. G. Farlow, Assistant Professor of Botany in Harvard University, to aid him. These gentlemen have made

a very complete study of the matter, but are unable to assign any cause for the taste. Their reports will be found appended to this."

LAYING OF A NEW LOW-SERVICE MAIN.

On May 10th, 1875, the City Council referred the subject of the condition of the high-service, and the laying of a new low-service main to the Board, who reported Dec. 2d, 1875. (See City Doc. No. 117, 1875.)

We make the following extracts from Mr. Joseph P. Davis' report on the new main, contained in the above document.

Mr. Davis begins with a description of the present mains. This information will be found in *Part Third*, and is omitted here:—

"The distance from Brookline reservoir to the point of junction of the mains on the Common is $4\frac{1}{10}$ miles by the 40-inch pipe route, and $4\frac{1}{5}$ miles by the 30-inch and 36-inch pipe route.

"The 30 and 36-inch mains were laid at the time the Cochituate works were built, and being uncoated pipes are badly tuberculated; the 40-inch was laid in 1859, with coated pipes, and probably is not much obstructed by tubercles.

"The sectional area of the supply mains that should be provided for a given population varies between wide limits, depending upon a variety of circumstances.

"In the case of Boston, where the mains are long and the distributing reservoirs at a rather low elevation, a large capacity is needed. An area that will give an initial velocity of flow of 2 feet per second, for the average consumption of the day hours, would usually be considered a large one.

"The average daily consumption from the Cochituate works may be taken in round numbers at 19,000,000 gallons. The consumption during the day hours is about one-fourth greater than the average for the whole day, or say at the rate of 37 cubic feet per second. With a velocity of 2 feet per second, the sectional area of mains that is required to provide for this rate of consumption is 18.5 square feet. The combined sectional area of the 30, 36 and 40 inch is 20.7 square feet, or 12 per cent. greater.

"To ascertain what the actual losses of head due to friction in the mains and sub-mains are, I have had observations taken at a number of points, the results of which will be found in the following table.

"The slight discrepancies that are noticeable between the losses at the same hours, at different points, are due to the facts that the gauges could not be read to small fractions of pounds, and that the readings of all the gauges observed in one day were not taken at exactly the same moment."

Here follows a "Table, showing loss of head due to friction in mains and sub-mains."

"The greatest loss of head during a week is ordinarily between the hours of 8 and 10 of Monday morning.

"It will be seen, from the table, that the loss on Monday, Oct. 18th, at the junction of the mains on the Common, was from 17 to 20 feet. (During the summer months this loss is somewhat greater.)

"On Wednesday, the 13th, the loss at the same hours and place was about 15 feet; at Warren bridge it was from 17 to 19 feet, and at the corner of Waltham and Tremont streets about 15½ feet. On Tuesday, the 12th, at the corner of Waltham and Tremont streets it was from 15 to 18 feet; at Dover-street bridge, from 17 to 18 feet, and at Fourth street, between O and P streets, in South Boston, from 17½ to 20 feet. On Thursday, the 14th, at the Roxbury crossing, it was about 15½ feet; at Commercial street, near Glover's corner, from 14 to 17 feet, and at Milton Lower Mills, 23½ feet (one observation at 10 A.M.).

"It will be noticed, first, that the losses of head are practically the same at all points along the line of the 30 and 36 inch pipes from the Roxbury crossing to the Common. This is due to the effect of the 40-inch main which joins them at the latter point. Second, that nearly the whole loss at any point where observations were taken, except at Milton Lower Mills, takes place in the large supply mains, or, in other words, only a small portion of the loss is due to friction in the sub-mains.

"Thus the loss at the northerly part of South Boston is very little greater than at the corner of Tremont and Waltham streets in Boston proper. So at Warren bridge, the loss is only from 2 to 4 feet greater than on the Common.

"It becomes evident from these figures that, to reduce the loss of head due to friction to any large extent, a new supply main must be laid from the reservoir, as not much can be gained by enlargement of the sub-mains.

"The following table, which gives the results of daily observations extending over a long period of time, will show the day and night losses at a number of points in the city, where the pressures have been taken on the small street pipes."

Here follows a "Table, showing night and day loss of head due to friction in mains and the smaller street pipes."

"It will be observed that as a rule the loss of head during the night is inconsiderable, and that the losses at 9 A.M. during 1875, or since important changes have been made in the pipe system, have been not very different from those given in the first table for the mains and sub-mains.

"With few exceptions all houses situated above grade 60 are supplied from the high-service works, and as the water in the Brookline reservoir is now kept at an elevation of at least 120 feet, the pressure, without loss by friction, would be equivalent to a head of 60 feet on the highest grounds of the low-service territory. The loss by friction at the hour of maximum consumption varies from 10 to 20 feet, as shown by the foregoing tables; hence the actual pressure on the higher grounds, at that hour, is from 40 to 50 feet, or sufficient for the supply of ordinary dwelling-houses. During the night hours tanks at elevations less than about 10 feet lower than the reservoir, or below grade 110, would be filled.

"About one and a quarter million gallons per day on an average are now required to supply the high-service pumps, and this quantity will be largely increased during the next two or three years on account of the recent annexations.

"The removal of the high-service machinery to the vicinity of Chestnut Hill reservoir, as proposed, will admit of an increase in the low-service consumption equal to the quantity required for the high-service supply, without further loss of head.

"From the foregoing the conclusion is reached that there is at present ample capacity of mains and sub-mains for the domestic supply, and I find, by estimate, there is also sufficient capacity to deliver a large quantity for extinguishing fires in addition to this supply.

"The completion of the Sudbury-river works will, however, give the city an abundant, instead of its present limited, supply, and a considerable increase of consumption is probable. Increase of consumption will necessitate a new main, the route and cost of which are questions to be considered.

"An examination of the map of the city suggests two routes. The first follows Beacon street, from the reservoir to West Chester Park street, where the new main would join with the 40-inch; from here a 30-inch branch main would pass along West Chester Park street to Tremont street, joining there the 30 and 36 inch pipes, and eventually be extended to South Boston through Hammond and Swett streets.

"The second follows Beacon street to Harvard street in Brookline, and thence passes through Harvard street, Longwood avenue, Parker and Prentiss streets, to Tremont, where the new main would join the 30 and 36 inch.

"It has already been pointed out that the loss of head is practically the same at all points on Tremont street from the Roxbury crossing of the Providence R. R. to the Common, from which it follows that if any increase of capacity of mains is needed it should be made between the reservoir and the crossing.

"The rebuilding and widening of Dover-street bridge (with probably a change in the position of the draw opening) may require a temporary discontinuance of the South Boston 20-inch low-service and 12-inch high-service supply-pipes, and consequently necessitate the laying of a new main to that section. This new main will naturally pass through Swett street, and may have its point of beginning near the Roxbury crossing, and follow Vernon, Washington, Hammond and Albany streets to Swett street. This will relieve the Tremont-street mains, from the crossing to Dover street, of about one half the supply of South Boston, or say of a supply for 30,000 people.

"With this relief it is not probable that any increase of the capacity of the mains north of the crossing will be needed for the supply of the city proper for many years, if ever.

"The following estimate is for a 48-inch pipe laid on the second route above described, which, from what precedes, appears to be the better of the two:—

18,000 feet of 48-inch pipe laid, at \$16.80	\$302,400 00
4,000 cubic yards of rock, at \$3.00	12,000 00
Extra for sheeting and pumping	9,000 00
Stop-valves, specials, bridge crossings, etc. . . .	20,000 00
	<hr/>
	\$343,400 00
Add 10 per cent. for contingencies	34,340 00
	<hr/>
	\$377,740 00

"Say \$375,000.

"I add an estimate of cost of a 30-inch main from the corner of Vernon and Tremont streets to the corner of Dorchester and Fourth streets, in South Boston.

15,200 lin. feet of 30-inch pipe laid, at \$8.30	\$126,160 00
Stop-valves, specials, bridge crossing, etc. . . .	8,500 00
	<hr/>
	\$134,660 00
Add 10 per cent. for contingencies	13,466 00
	<hr/>
	\$148 026 00

"Say \$150,000.

"Respectfully submitted,

"JOS. P. DAVIS, *City Engineer.*"

No action has yet been taken on the subject of the above report.

Dec. 23d the Board voted "to ask the City Council to request the Mayor to petition the General Court for an act authorizing the City of Boston to further control and protect its sources of water supply from infringement or pollution, and to control and regulate the use of the land and driveway around Chestnut Hill and Brookline reservoirs ; also for an act forbidding the acquisition of adverse prescriptive rights, by any person, with respect to real estate held by the city in connection with its sources of water supply."

The above vote resulted in the request asked for. When the matter came before the Committee on Water Supply and Drainage of the House of Representatives, they reported a general act giving authority to towns and cities to make regulations governing reservoirs and driveways within their limits. The matter of adverse prescriptive rights was asked for by the city on the ground that railway corporations have the same favor extended to them, and are not liable to lose the title to any property by reason of occupancy or encroachments, but this section was stricken out in the Judiciary Committee. After the passage of this act the City Council adopted an ordinance (see *Part Fourth*) for the regulation of Chestnut Hill reservoir.

"CHARGING DEPARTMENTS FOR WATER.

"Report of Joint Standing Committee on Water on the subject of charging City Departments for the use of Water.

"IN COMMON COUNCIL, Jan. 27, 1876.

"The Joint Standing Committee on Water, who were requested to consider the expediency of reporting an ordinance amending Sections 46 and 47 of the ordinance in relation to water, so that the various city departments now charged for the use of water may be relieved, wholly or in part, of that charge, having considered the subject, would respectfully submit the following report:—

"The committee have conferred on the subject with the Water Registrar, and received from him information showing in detail the present system of charging each of the city departments for its use of water, and the amounts charged to each for the year 1875. The Registrar's communication is appended to this report.

"It will be seen that the policy of assessing any city department for the use of water was first authorized by the City Council in 1853, and in 1869 the City Council authorized a charge to be made to the Fire Department of \$30 per annum for each hydrant and reservoir located; \$18 for the use of the water, and \$12 for the maintenance. From that time forward it has been the policy of the Water Department to charge each of the departments under the City Government for the amount of water used. The system is shown by the table for the year 1875 in the communication of the Water Registrar.

"The act of the Legislature which authorized the introduction of the Cochituate water provided that the water-rates charged should be sufficient to meet the yearly interest on the cost resulting from the carrying out of the scheme, and the yearly

expense of maintaining the works. It should be borne in mind that this cost was largely enhanced by the fact that pipes and reservoirs had to be provided, specially on account of the Fire Department, which were of much larger size than those required for domestic and manufacturing purposes. The Parker Hill reservoir was built almost expressly for the purpose of providing an ample supply of water for districts supplied by the high-service, in case of fire in those localities. Since the great fire of 1872 more than half a million dollars has been expended in replacing the water-pipes in the business portion of the city with much larger ones, in order to provide for greater security in case of another large conflagration, the object aimed at being to insure a perfectly abundant supply of water when, in certain exigencies, the forces of the Fire Department should be concentrated at a single point. Thus, the present system of charging the Fire Department for the use of water, and for the maintenance of the hydrants and reservoirs—and at the present rates—would seem to be as equitable a one as could be devised. It causes that department (as representing the interests of all classes in our community) to bear the interest on these large expenditures made by the city on account of the peculiar needs of the department, and the cost of maintaining the large water-pipes and other appurtenances introduced for its especial use, *instead* of assessing this expense upon the individual water-takers only.

“This principle would seem to the committee to also apply to the whole system of charging all the city departments for the water used by or on account of each, going to show, with the other items of expense, the exact cost incurred by the city in maintaining each of its departments.

“For these reasons the committee believe that the system in vogue is the proper one, and would respectfully report that no action is necessary under the order.

“Respectfully submitted.

S. B. STEBBINS,
JOHN T. CLARK,
A. O. BIGELOW,
JOHN SWEETSER,
GEORGE A. SHAW,
MARCELLUS DAY,
JOHN W. FRASER,
RICHARD BEECHING,

} *Committee on Water.*

“OFFICE OF THE WATER REGISTRAR,
CITY HALL, BOSTON, Jan. 24, 1876.

“SOLOMON B. STEBBINS, Esq., *Chairman*:—

“In reply to your note of the 18th inst., in relation to the consideration, by the Joint Standing Committee on Water, of the subject of releasing the several city departments of the charge for water, and asking information pertinent thereto; also asking for the sums paid for water by these departments respectively, for the year 1875, I have the honor to reply, that the aggregate sum of money received from all the city departments for water furnished during the year 1875 was \$116,500.41. Herewith, I hand you the list, with amounts under each head respectively.

“On the 11th of January, 1853, the City Council authorized the Water Board to assess water-rates on all Public Buildings, previous to which time no such charges had been made.

“In 1869 the City Council authorized the additional charge to the Fire Department, after January 1st, 1870, of \$30, for each hydrant and reservoir located, \$18 of which was for the use of water, and \$12 for the maintenance. In my opinion the above

charges are moderate in view of the quantity of water likely to be required, and the cost of establishing and maintaining the hydrants, together with the large sums expended, from time to time, for the enlargement of main pipes, and other appurtenances for *fire purposes* (as for every other service the six-inch mains would be ample), amounting in the aggregate, since 1871, to \$500,000.

"Some further figures will be pertinent in view of what I shall add in favor of preserving the present system, by which the Water Department is enabled to show the water it furnishes; in other words, in favor of a system which at all times fairly shows the cost in capital invested by the city for furnishing water for all and every purpose, and, on the other side, the net revenue upon the capital invested.

"The figures are as follows:—

The total receipts from the sale of water in 1875 were	\$1,000,000 00
The total number of water-takers	44,000
<hr/>	
Of this number of takers 30,000 are dwelling-houses, which pay in the aggregate	\$490,000 00
14,000 are business places, including hotels, which pay	394,000 00
The City Departments, as per annexed schedule, pay (say)	116,000 00
	<hr/>
	\$1,000,000 00

"In the City Department item of \$116,000, the Water Department charge the Fire Department for hydrants, reservoirs, and maintenance (exclusive of Engine, Hose and Ladder Houses, which charge amounts to \$890), \$90,312; another item is \$7,559.25, which includes the School, Street and Health Departments, and various small services, all told, like the Fire Department item, not expedient to measure; and the balance of \$116,000 is \$18,629.16, which is expedient, and is measured and paid for by meters.

"I will now respectfully submit that it is important for the Water Department at all times to know, as far as practicable, the amount of water required; also, on occasions of short supply, it is essential to be cognizant of any wastage; and charging for the use of water is help to this end. For instance, there are two items in the \$18,629.16 aggregated above, which are large, and should exhibit some degree of uniformity in their needs for water. One is the City Hospital, that pays \$1,983.35, against \$770.96 paid by the Lunatic Hospital. The other item is the Suffolk County Court House, which pays \$1,736.50 against \$303.17, paid by City Hall; both cases are served by meters, and, aggregated together, show the consumption to be six times larger than the City Hall item, and suggests a waste which the Water Department would be called upon to look into in case of short supply, or whenever full pay for water does not recompense for such contingency. Secondly, the wisdom of showing the exact cost of every department or institution of the city has been recognized, and exists all through the civic concerns of Boston, and water is one of these costs; and whenever any portion of its cost is created for the benefit of the whole community, it should be borne by taxation of the whole community, and this presents perhaps the strongest argument against doing away with these charges. It is simply this,—the \$116,000 must be reimbursed to the Water Department; it is now paid by ordinary equal taxation upon the whole community; but if the city departments are not assessed as now, this amount must be spread over the 44,000 present water-takers, and would be oppressive upon the large takers, which are manufacturing or business interests. Thus 30,000 dwelling-houses pay \$490,000, while 14,000 business takers pay \$394,000; spreading the \$116,000 over these bills, the proportion of the former would be \$64,298, and the latter \$51,702. This sum of \$116,000 is not felt in the general assessment of taxes,

but, if put upon the business customers of the Water Department, it is an addition of nearly 10 per cent. to their present bills. In a word, the existing just system of charges by the Water Department, under the authority of the city ordinances, is to cause the whole community, in their general tax-bills, to pay \$116,000, for service done for the whole community, which otherwise would have to be paid by water-takers alone; and, furthermore, two-fifths of this amount would fall upon the business portions of the community.

"Believing the above is fully responsive to your request, and with the desire to furnish you with all possible information upon the subject-matter,

"I am, with respect,

"WILLIAM F. DAVIS,

"Water Registrar.

"Statement showing the amount of revenue derived from the various City Departments for the use of water for the year 1875:—

North and South Ferries by meters	.	.	.	.	.	\$5,381 53	
House of Correction	"	.	.	.	.	4,465 47	
City Hospital	"	.	.	.	.	1,983 35	
Suffolk County Court House	"	.	.	.	.	1,736 50	
Deer Island Institutions	"	.	.	.	.	1,261 05	
Police Stations	"	.	.	.	.	1,130 31	
Lunatic Hospitals	"	.	.	.	.	770 96	
Suffolk County Jail	"	.	.	.	.	483 17	
Committee on Bathing	"	.	.	.	.	368 52	
Cedar Grove Cemetery	"	.	.	.	.	331 00	
City Hall	"	.	.	.	.	303 17	
Board of Health (urinals)	"	.	.	.	.	262 98	
Temporary Home	"	.	.	.	.	98 51	
Charity Building	"	.	.	.	.	52 64	
							\$18,629 16
Engine Houses, specific rate	.	.	.	.	.	890 00	
Public Schools	"	.	.	.	.	3,214 00	
Drinking Fountains	"	.	.	.	.	920 00	
Health Department	.	.	.	.	.	576 25	
Sprinkling Streets	.	.	.	.	.	500 00	
Paving Department	.	.	.	.	.	271 50	
Sewer Department	.	.	.	.	.	250 00	
Steamer Flanders	.	.	.	.	.	200 00	
" Morrison	.	.	.	.	.	200 00	
" Little	.	.	.	.	.	100 00	
Public Urinals	.	.	.	.	.	120 00	
Probate Building	.	.	.	.	.	75 00	
Public Library	.	.	.	.	.	60 00	
Branch Library	.	.	.	.	.	43 50	
Faneuil Hall	.	.	.	.	.	40 00	
Small-pox Hospital	.	.	.	.	.	25 00	
Public Garden	.	.	.	.	.	25 00	
Lockup, Ward 16	.	.	.	.	.	14 00	
Municipal Court	.	.	.	.	.	14 00	
Carried forward	.	.	.	.	.	\$7,528 25	\$18,629 16

<i>Brought forward</i>	.	.	.	.	.	.	.	\$7,528 25	\$18,629 16
Office (City Scales)	.	.	.	.	.	.	.	11 00	
House of Reception	.	.	.	.	.	.	.	10 00	
Deer Park	.	.	.	.	.	.	.	10 00	
									7,559 25
Fire Hydrants	.	.	.	.	.	.	.	\$52,524 00	
“ Reservoirs	.	.	.	.	.	.	.	1,764 00	
For maintenance	.	.	.	.	.	.	.	36,024 00	
									90,312 00
									\$116,500 41

The proposed amendment failed to pass.

1876.

On Jan. 24th, Mr. Solomon B. Stebbins, from the Board of Aldermen, and Mr. Nahum M. Morrison, from the Common Council, were elected members of the Water Board. The same day the Water Board passed the following resolution : —

Resolved, That the thanks of this Board be, and they are hereby presented to Messrs. Charles J. Prescott, Amos L. Noyes and Wm. G. Thacher, our retiring members, for the fidelity and ability with which they have discharged the various duties incumbent upon them. We would also tender to them our hearty wishes for their future prosperity and happiness.

On Jan. 27th, Mr. Stebbins was appointed on the Committee on the Western Division, and Mr. Morrison was appointed on the Committee on the Eastern Division, and also (Feb. 3d) on the Committee on Water Registrar's Department.

Feb. 10th. Mr. Wm. F. Davis was re-elected Water Registrar by the City Council.

Feb. 17th. Mr. Augustus Parker was elected a member of the Water Board, from the Common Council.

Feb. 16th. A pipe contract was awarded to Jesse W. Starr & Son, for 6, 8 and 12-inch pipe, Class B per ton of 2,240 lbs., at \$35; 48-inch pipe, \$33; 60-inch pipe, \$42. Special castings, \$56.

March 21st occurred the first of a series of freshets. The amount of rain and snow at the lake was only 2.27 inches, but the water ran off the surface of the ground so rapidly that it rose from 11 feet 1 inch on the 21st to 12 feet 10 inches on the 25th; a gain of 21 inches in 4 days. During a part of this time the lake filled 13 inches in 24 hours.

The amount of waste from the Cochituate water-shed varied from 10 to 21 inches in depth on the new weir, covering a period of 18 days.

Warren Fisher having petitioned the City Council to have Fisher avenue, on Fisher Hill, put in order, the Mayor approved an order Feb. 8th, directing the Water Board to execute the conditions of the agreement entered into with Mr. Fisher, and on March 6th the Water Board sent a communication to the Council stating that all the conditions of the agreement had been complied with.

On May 1st the Board was called together to organize. The following officers were elected : —

President	L. MILES STANDISH.
Clerk	WALTER E. SWAN.
Superintendent Eastern Division .	EZEKIEL R. JONES.
Superintendent Western Division .	DESMOND FITZGERALD.

Voted, To employ Mr. A. Stanwood in the same capacity as heretofore, at a salary of \$3,500 per year.

The President appointed the following committees : —

Western Division	Messrs, CUTTER, STEBBINS and PARKER.
Eastern Division	" WHITE, MORRISON and STANDISH.
Water Registrar's Department	" MORRISON, PARKER and STANDISH.
New Supply	" STANDISH, CUTTER and POWERS.

Voted, That the regular meetings of the Board be held on Thursday, at half past twelve o'clock.

May 1st. The Board made their annual report. Attention is called to the following facts : The laying of 19 miles of main pipes and the setting of 240 hydrants in the West Roxbury and Brighton Districts at a cost of about \$265,000, during the past year ; and a little over 12 miles of pipes in the oldest sections of the city. Total, 34 miles, 1,575 feet main pipes laid ; 1,237 service pipes.

The principal streets of Jamaica Plain and Brighton, with the exception of those in the latter district which are too high to be reached by the low service, are now piped.

The building of a pipe bridge at Cottage Farm.

In the new districts of the city it has been decided to place Lowry hydrants at the intersections of the streets, and post-hydrants at intermediate points.

The running of the old conduit as a pipe under a head for 338 days out of the year.

The laying of the new siphon at Newton Lower Falls.

The completion of setting the bounds on the aqueduct as far as Brookline reservoir.

EAST BOSTON WATER SUPPLY CHANGED FROM THE MYSTIC TO THE COCHITUATE.

The contract for supplying East Boston with water from the Mystic source was made with the city of Charlestown Oct. 1st, 1869 (see page 9). From this time until the spring of 1875, water was supplied in accordance with this contract. Early in April, 1875, complaints against the purity of the water became numerous, and the attention of the Water Board was called so often to the grievances of the people of East Boston that they appointed a special meeting April 7th to see what steps could be taken in the way of relief. The City Solicitor was consulted, and he decided that there could be no legal objections to changing the supply from the Mystic to the Cochituate. Accordingly, the Committee on Eastern Division were authorized to make the change, which was effected April 21st.

On Oct. 11th an order was introduced into the City Council requesting the "Committee on Water to report what action is necessary to enable the Collector to adjust his accounts for East Boston."

On Oct. 18th the committee reported as follows:—

" On the 21st of April last, upon representations made by the citizens of East Boston that the water from Mystic pond was impure and unfit for domestic use, the Water Board changed the source of supply from the Mystic to the Cochituate.

"As the contract is still in force, the collections from water rents have been paid to the credit of the Mystic Water Works, and must, in the opinion of the City Solicitor, continue to be so paid until the contract is annulled. It does not appear that there is anything in the other contracts entered into by the City of Charlestown, or in the terms of the Mystic Water Bonds, which prevents the City of Boston from annulling the contract, and thereafter crediting the department which furnishes the water with the income derived therefrom. The amount paid under the contract to the Mystic Water Department for water furnished from the Cochituate Department (some \$15,000) cannot be diverted."

The following order was reported, and adopted by the Council:—

"*Ordered*, That on and after the passage of this order the agreement.

entered into on the first day of October, A.D. 1869, by and between the City of Charlestown, acting by its Mystic Water Board thereto duly authorized, and the City of Boston, acting by its Cochituate Water Board thereto duly authorized, for the supply of water from Mystic pond to the inhabitants of East Boston and the public institutions at Deer Island, said agreement being entered with Middlesex Southern District Deeds, Lib. 1071, Fol. 550, be, and the same is hereby, cancelled and annulled.

"Approved Oct. 30th, 1875."

On Dec. 2d, 1875, the Cochituate Water Board voted to ask the Mystic Water Board to turn on their water to East Boston.

The request was made on account of the difficulty experienced in keeping up the head in the city proper. A sudden change to severely cold weather led to a wholesale waste of water, which was rapidly drawing down the level of the Brookline reservoir. Chestnut Hill reservoir was shut off from the city at the time, owing to the bad taste of the water in that basin.

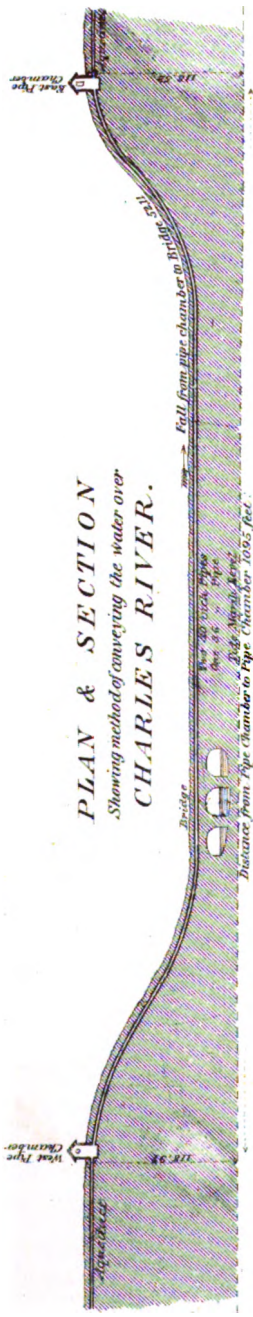
The Mystic Water Board responded by ordering their water turned on at once, and the Cochituate system was relieved to the amount of the consumption in East Boston.

On March 30th, 1876, an arrangement was made between the two Boards for the supply of East Boston with the Mystic water between Jan. 1st and July 1st, 1876, on the same terms contained in the old contract.

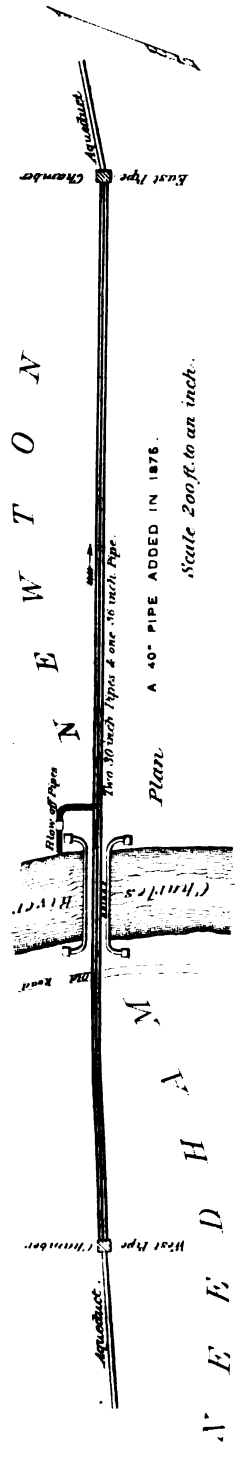
DUG POND IN NATICK.

The town of Natick secured an act on March 15th, 1873, allowing them to take water from Dug pond.

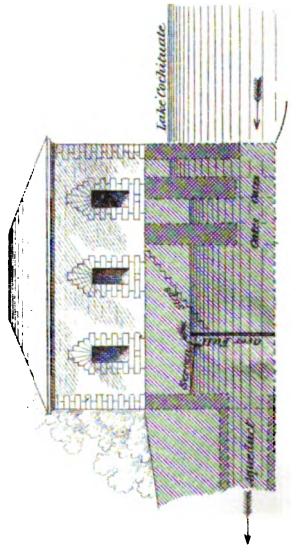
Dug or Monsemog pond formed part of the original conveyance to the city by Mr. Knight in 1846. It is about one hundred and thirteen feet from the southern shore of Lake Cochituate and separated from the peat meadow on the Southern Division by the county road; a brick culvert two feet in diameter is laid beneath the road, through which the waters from the pond have been allowed to discharge into the meadow, and thence pass into the lake. It contains about forty-four and one-half acres. The shore all around is a steep, gravelly bank, eight or ten feet high, and the pond naturally derives its water wholly from springs. The city had acquired also a right to divert the waters of a brook on the east side into it, and thereby insure the filling up of the pond every winter. The water is quite deep and remarkably pure and soft, and formed an important tributary to the lake.



PLAN & SECTION
Showing method of conveying the water over
CHARLES RIVER.



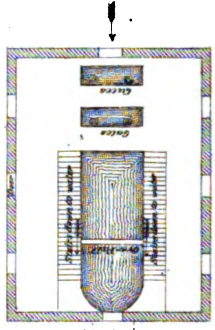
PLAN. A 40" PIPE ADDED IN 1876.
Scale 200 ft. to an inch.



Elevation and Half Section of Gate House at
Lake Cochituate.



Section of Brick Aqueduct.



Plan of Gate House at
Lake Cochituate.

The amount of land that the city had originally embraced only a small portion of the lake. As the city had no other source of land all around the north end of the lake, it was necessary for it to offer the land with the town, to offer the land for the amount that it had originally embraced.

The following vote was passed by the city council in the interviews between committee and city council.

"Resolved, That to sell the town of Dig point, for the sum of \$100,000, for water or water rights.

The sum was found to be the amount of the lake, for water or water rights.

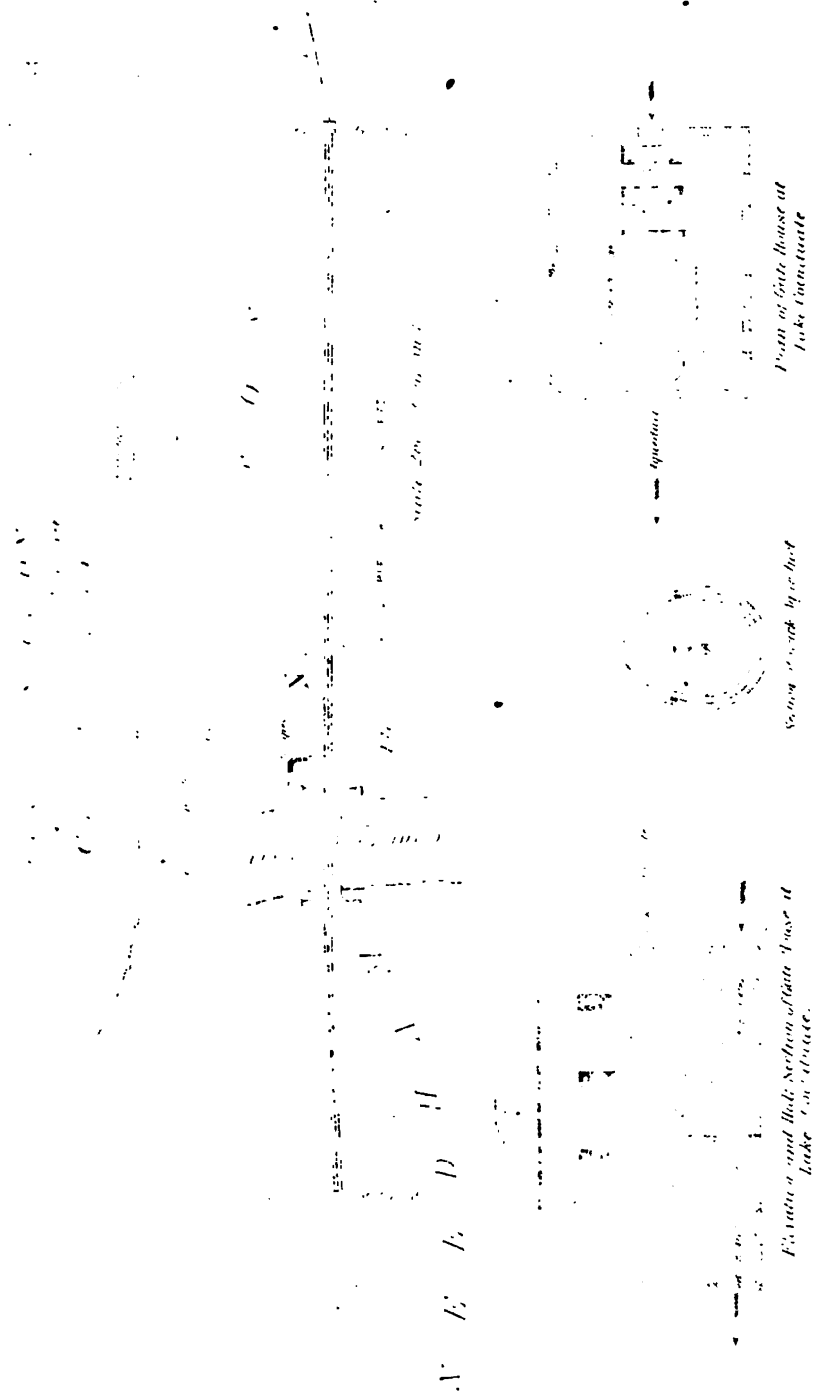
The sale was consummated for the above amount. The surplus of the lake, for water or water rights.

A NEW SECTION OF THE ACT.

Among the projects brought forward from the city council, the supply of water was the subject of a new siphon. The river on the line of the Canal and aqueduct. The siphon consisted of three iron pipes, the first of which was 36 inches in diameter, and the second and third were 30 inches in diameter. The horizontal distance between the two siphons was 52.11 feet below the level of the river on a bridge of three elliptical arches.

On April 6th the City Engineer, Mr. J. B. Smith, reported to the Board of Public Works, that the water at 123.50 at Chesnut Hill, the addition of a fourth siphon pipe, the water would deliver three-quarter million of gallons per day, and the lake, twenty-three million of gallons per day. The cost of new chamber and pipe for cast-iron pipe, \$21,500."

He says: "The siphons will deliver water at 123.50, and the water that the lake can deliver is 123.50. It hardly seems a basis for the city of adding a fourth siphon. Should the city take the water or the lake be taken, so that the water in the lake be maintained at a height to deliver the water at 123.50 head, then the addition of a fourth siphon pipe of greater capacity is a necessity, especially if the city is to continue to grow so rapidly. My calculations indicate that there is some objection to the present



Point of entry house at
Lake Umbagog

Some work by a boat

Excavation and the section of the house at
Lake Umbagog

The amount of land taken by the Natick Board, in accordance with their act, embraced only a small piece for their gate-house and the outlet into the lake. As the city had been at some expense in procuring strips of land all around the margin of the pond, it was thought best, in settling with the town, to offer them the land held in fee by the city for the same amount that it had originally cost the city.

The following vote was passed April 29th, 1875, after a number of interviews between committees of the two Boards:—

"Voted, To sell the town of Natick all the lands owned by the city, situated about Dug pond, for the cost of the same to the City of Boston."

This sum was found to be \$3,644.13, exclusive of any amounts paid for water or water rights.

The sale was consummated Feb. 19th, 1876, by the payment of the above amount. The surplus water not used by Natick will still flow into the lake.

A NEW SIPHON PIPE ACROSS CHARLES RIVER.

Among the projects brought forward from time to time for increasing the supply of water was the laying of a new siphon pipe across Charles river on the line of the Cochituate aqueduct. The existing siphons consisted of three iron mains, two 30-inch and one 36-inch diameter. The horizontal distance between the siphon chambers was 1,059 feet, and the pipes descended 52.11 feet below the level of the aqueduct, crossing the river on a bridge of three elliptical granite arches.

On April 6th the City Engineer reported to the Board: "With the water at 123.50 at Chestnut Hill reservoir, and the conduit flowing full, the addition of a fourth siphon pipe, 36-inch diameter, would increase the delivery three-quarter million gallons per day. With a four-feet head at the lake, twenty-three million gallons could be secured per day. The cost of new chamber and pipe would be, for wrought-iron pipe, \$16,000; for cast-iron pipe, \$21,500."

He says: "The siphons with their present capacity will deliver all the water that the lake can furnish in ordinary seasons, and therefore it hardly seems advisable to go to the expense of adding a new pipe at this time. Should the right to turn the Sudbury or other supply into the lake be taken, so that the level of the water in the lake may be maintained at a height that will permit of running the conduit under a head, then the addition of a new pipe may be of great value, and perhaps a necessity, especially if the consumption continues to increase rapidly. My calculations indicate that there is some obstruction in the present

pipes, that is, the loss of head that now takes place at Charles river is greater than what should be required to force through the siphons the quantity of water now flowing, even allowing that they are badly tuberculated."

The city having acquired the right of turning Sudbury river into the lake, the Board determined to lay a new siphon pipe in accordance with the recommendation of the City Engineer. On Feb. 26th, 1875, the Mayor approved an order giving the requisite authority to the Board, and on the same day the City Engineer was authorized to prepare the necessary plans and specifications. The pipe, 40-inch in diameter, was contracted for in March, and the work of laying was begun May 10th, 1875. On May 3d the Board voted to authorize the Engineer to construct the necessary siphon chambers. As the three pipes already laid occupied the whole width of the bridge, the new pipe was laid on top of the other three.

Work on the pipe-chambers was begun June 14th. "They are located some 75 or 100 feet further away from the river valley than the old ones. To build them a section of the conduit on each side of the river was stripped bare of its earth covering, and suspended by chains from strong overhead beams; the masonry of the chambers was then laid to enclose these sections, which were afterwards cut out. The conduit was flowing nearly full while suspended, and although the mortar of the section on the east side of the river had never properly set, and was of little service except as a packing to the joints between the bricks, it was found that the leakage could be easily controlled or entirely stopped by driving wedges between the chains and masonry. While the sections were being cut out the water was shut off for one day, which was the only interruption to the flow during the time of construction. It is estimated that the new pipe increases the capacity of the conduit, when flowing under a four-foot head, nearly two million gallons per day."

The new siphon was put into use July 28th.

The work was superintended by Mr. W. F. Learned, of the City Engineer's office.

A NEW WATER BOARD.

After the annexation of Charlestown, West Roxbury and Brighton to the city of Boston, January 5th, 1874, the subject of uniting the Mystic and Cochituate Water Boards, and reorganizing the entire Water Department, was brought up in the City Council.

On February 9th, 1874, an order was introduced requesting the Joint Standing Committee on Water "to consider and report upon the expediency of providing by ordinance for the establishment of a single Board to exercise the powers now vested in the Cochituate and Mystic Water Boards, the members of which shall be appointed by the Mayor, with the approval of the City Council, and compensated for their services."

On February 20th this order was approved.

On March 9th, the committee reported in part, reviewing the ordinances bearing on the matter, and recommending that an act be procured from the Legislature. (See City Document No. 31, 1874.)

We make the following extract from this report:—

"During the next few years it will be necessary to spend a very large amount of money in procuring an additional supply of water from some source; and in view of that fact, and also of the increased duties caused by the rapid growth of the city, it is evident that some change is necessary in the present organizations having charge of the Water Department in order to insure economy and efficiency in the management of its affairs. Those who have been at the head of the Cochituate and Mystic Boards, during a number of years past, are unanimous in the opinion, that the present system should be changed without delay. It appears, from the opinion of the City Solicitor, that it will be necessary to apply to the Legislature for authority to organize the department upon a proper basis; and, without attempting at this time to designate the form of organization which should be adopted, the committee would recommend the passage of the accompanying order, requesting the Mayor to petition the Legislature for authority to make such changes as the City Council may deem expedient.

"For the Committee,

"S. B. STEBBINS, *Chairman*."

On March 13th an order was approved requesting the Mayor to petition for an act in accordance with the above recommendation, and on the 16th of the following April the Joint Standing Committee on Water reported that an act had been obtained (see *Part Fourth*) which, after giving in full, they proceed to say:—

"In view of the large expenditures which the city will be obliged to make during the next few years in procuring an additional supply of water, it seems hardly necessary to urge the importance of acting without delay upon the authority granted in this act.

"At a hearing given by the committee on the question of reorganizing the Cochituate and Mystic Water Boards, the past and present Presidents of those Boards were unanimous in the opinion that a reorganization is absolutely necessary.

"Mr. John A. Haven, the President of the Cochituate Water Board, being unable, on account of illness, to attend the meeting, sent the following communication, which

may be taken as expressing substantially the views entertained by Hon. Otis Norcross, President of the Board in 1865 and 1866, Nathaniel J. Bradlee, Esq., President in 1868, 1869 and 1870, and Charles H. Allen, Esq., President in 1871 and 1872.

“BOSTON, March 7, 1874.

“ALD. S. B. STEBBINS, *Chairman Committee on Water, City Council*:—

“DEAR SIR,—Last evening I received notice of a meeting of the Committee on Water to consider the recent order of inquiry concerning the establishment of a permanent Water Board. Fearing, from continued indisposition, that I shall not be able to meet your committee, I have thought it proper to state to you briefly my views of the proposed change.

“I am decidedly of the opinion that a permanent, compact and working board of management would far better subserve the interests of the city than the present organization, and this opinion I know is concurred in by many of the past active members of the Board, including particularly its past Presidents, Messrs. N. J. Bradlee and C. H. Allen, as well as by many prominent city officers, past and present, who have given much attention to the subject. The real work, constituted as is the present Water Board, must of necessity fall upon some two or three of its members, and, if these are actively engaged in business of their own, they cannot easily give that amount of time and attention really required to systematize in detail the large amount of business in the different departments so as to produce the best results. If this difficulty is found while the duty is confined to the present finished or Cochituate system, it is likely to become still greater when the duties of management are so much enlarged by extended territory, by extension of the high-service, and by the labors connected with the proposed new supply.

“The result of some four years' pretty active experience has led me to the very decided conclusions:—

“*First.* That the Board should consist of *three* members only.

“*Second.* Their entire time should be given to the work, for which they should be paid a fair compensation.

“*Third.* That their term of office should at least embrace the full time required to construct the new work, and the settlement of the great number of complicated and delicate questions that must arise from the magnitude of this new work. The numerous contracts for construction, the settlement of land and other damages, and the many other incidental matters require, for successful results, a well-settled and continuous business policy.

“While the Board is being continually changed in membership—as under the present arrangement—it is impossible to secure that desired *system* and consequent accountability which business men of largely extended operations would desire to make sure of in their own transactions. The business operations of the Water Board for the next five years will, of necessity, be large and complicated, and its supervision should be regular, continuous, and intelligent, to produce the desired results of business success. More particularly is it desirable that the Board should be permanent, and guided by a well-defined business policy, where questions arise between the engineer and the contractors, and where the engineer should, for the best interests of the city, be certain of receiving that support, which results from a permanent and *continuous* policy, in all controverted questions.

“It is very apparent that the present organization of the Board is not fitted for the

present emergency arising from so large an increase in the business, and I have but little doubt that the Water Committee are fully satisfied that if one reason existed for the appointment of a permanent Fire Commission, *many more* reasons exist for the appointment of a compact and permanent Board to take charge of the rapidly increasing water department, in the completion of which many millions of dollars must be expended within the next few years.

"I have been compelled to give this matter more than ordinary attention, and have briefly, but, I fear, very inadequately, given the result of my reflections; but I think you will find that they agree in the main with those of every one who has heretofore been actively engaged in the management of these works, or others of like magnitude.

"Respectfully, your obedient servant,

"JOHN A. HAVEN.

"To carry out the provisions of the Act of the Legislature, the committee have prepared, and would recommend the passage of, the accompanying Ordinance, organizing the Boston Water Board, and giving it all the powers heretofore vested in, and exercised by, the Cochituate and Mystic Water Boards.

<p>"S. B. STEBBINS, JOHN T. CLARK, ALANSON BIGELOW, FRED'K PEASE, EBENEZER ADAMS, ALONZO WARREN, WM. H. KENT, FRANCIS HUNNEWELL,</p>	}	Committee."
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The ordinance is not given, as it failed to pass. It will be found in City Document No. 40.

On May 18th, a minority report appeared (see City Doc. No. 54), taking the ground that "appointed commissions are unrepresentative and undemocratic."

This report ends by saying:—

"Competent heads of departments, with good committees, will manage the affairs of the city better and cheaper, in our opinion, than commissions will.

"We therefore respectfully report that it is inexpedient to legislate under the present statute.

"FRANCIS A. PETERS,
A. J. HALL."

The ordinance report submitted by the majority in the mean time had been referred to the Committee on Ordinances, who reported May 18th, a new draft. (See City Doc. No. 53, 1874.)

The ordinance, as reported by this committee, was adopted by the Board of Aldermen on June 29th following, but failed in the Common Council by a large vote, after a protracted discussion, "principally (as it

is understood) by reason of an alleged defect in the act of the Legislature. There was a question whether, under the terms of the act, the Board, when established, would not have authority to take lands and water-rights without any further action on the part of the City Council; and as the subject of procuring an additional supply of water from some source was then under consideration, the doubt on that point, as to the powers of the Board, was sufficient to cause the rejection of the ordinance."

The matter was brought before the Council early in the year 1875. On Feb. 20th an order was approved requesting the Committee on Ordinances to report, if they should deem it expedient, an ordinance uniting the two Boards.

On March 1st the committee reported in part, with an order requesting the Mayor to petition for an act giving the Water Board, when established under chapter 179, acts 1874, full authority to act as the AGENTS of the city for taking land, etc.

This order passed, and was approved by the Mayor, March 2d, 1875.

On March 25th the desired act having been procured, "making it clear that the Board cannot act until empowered by the city," the Committee on Ordinances made a report (City Doc. No. 38, 1875), reviewing some of the facts and recommending the passage of an ordinance to establish the Boston Water Board, to consist of three persons, which was referred to the Joint Standing Committee on Water.

On May 13th the committee reported two ordinances to establish a Water Board (see City Doc. No. 64, 1875), being a majority and minority report. The following is the majority report. The ordinance is omitted, as it failed to pass.

"IN COMMON COUNCIL, May 13, 1875.

"The Joint Standing Committee on Water, to whom were referred the order and ordinance in relation to the reorganization of the Cochituate and Mystic Water Boards, having considered the subject, would respectfully recommend the passage of the accompanying ordinance, which provides for the union of the two Boards in accordance with the provisions of the act authorizing the annexation of Charlestown to Boston. Under the provisions of the proposed ordinance, the new Board will consist of nine persons, namely: one member of the Board of Aldermen, and two members of the Common Council, elected annually by concurrent vote of the City Council; one person (not a member of the City Council), appointed by the Mayor, with the approval of the City Council, for a term of three years; and five persons (not members of the City Council), elected by concurrent vote of the City Council, to serve for a period of three years each. The person appointed by the Mayor is to be President of the Board; devote all his time to the duties of the office, and receive such compensation for his services as the City Council may determine. The other members of the

Board are to serve without compensation. On the first organization of this Board, it is necessary to include the member of the present Mystic Water Board whose term of office expires on the first of April, 1876.

"The powers and duties conferred on the new Board are the same as those proposed to be conferred on the Boston Water Board.

"Respectfully submitted,

<p>"JOHN T. CLARK, JOHN SWEETSER, N. S. WILBUR, HENRY W. WILSON, EMERY D. LEIGHTON, P. EDWARDS.</p>	}	Committee."
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The following is the minority report. The ordinance is omitted, as it failed to pass.

"IN COMMON COUNCIL, May 13, 1875.

"The undersigned, members of the Committee on Water, respectfully dissent from the recommendation of the majority in regard to the reorganization of the Cochituate Water Board, and beg leave to state briefly their reasons therefor.

"The proposed ordinance provides that the President of the Water Board shall be appointed by the Mayor, with the approval of the City Council, and compensated for his services; and that the eight other members of the Board shall be elected by the City Council, to serve without compensation. As the president has no greater power, and no greater responsibility, than the other members of the Board, there is no reason why he should be paid and the others give their services gratuitously. It is a body of equals, and no member, whether paid or unpaid, can divest himself of his responsibility. Being equally responsible, therefore, they must give their time and attention with equal fidelity to the duties of the office; otherwise they cannot act intelligently upon the business with which they have been intrusted. If it is intended that the unpaid members shall be brought together merely for the purpose of registering the decrees of the paid member, then it would be better to leave things where they are now, because we should have a Board controlled by one man, who would be burdened with only one-ninth of the responsibility. In a Board so constituted there would be neither harmony nor efficiency; and it is not at all probable that we should be able to find suitable men who would be willing to accept any other position than that of president.

"The undersigned are so impressed with the importance of having the great work in which the city is now engaged placed under the supervision of competent and responsible persons, who are paid for their services, that they would be willing, if the authority existed, to recommend that commissioners should be appointed to have special charge of the enlargement of the water works, and to hold office until those works are completed; but it appears, upon an examination of the statutes, that the City Council cannot provide for the appointment of a commission to exercise those powers independent of the present Cochituate Board.

"The Cochituate and Mystic Boards can be united under the name of the Boston Water Board, as provided by the special act of the Legislature; or they can be kept distinct, and the Cochituate Board can be reorganized so as to consist of three persons appointed by the Mayor, with the approval of the City Council, and compensated for their services. Under the present circumstances, the undersigned are of opinion that

it would be expedient to adopt the latter course; and they would respectfully recommend that the accompanying ordinance, providing for a reorganization of the Cochituate Board in the manner suggested, be substituted for the ordinance reported by the majority.

S. B. STEBBINS,
A. O. BIGELOW."

The Common Council adopted the report of the majority, and the Board of Aldermen adopted that of the minority. The matter passed several times between the two branches, and finally, June 28th, a Committee of Conference was appointed, who reported, July 19th, that they were unable to agree, when the committee was discharged.

On Dec. 16th the Cochituate Water Board passed the following vote, which they transmitted to the Mayor:—

Voted, That it is the opinion of this Board that the entire Water Department of this city should be placed in the hands of a commission, who should give their whole time to the duties of the office, and be suitably compensated for their services.

Mayor Cobb, in his Inaugural address, Jan., 1876, referred to a new Board, as follows:—

"I urgently recommend that the expenditures on the new work, and the management of the whole property, when completed, be committed to a paid commission, who shall be paid for their services, give their whole time to the duties of the office, and be held strictly responsible to the City Council. Becoming thoroughly conversant with the affairs of the department, they would be prepared at all times to answer the questions and meet the exigencies that are constantly arising, to make contracts and provide supplies on the best terms, and keep a watchful eye on every item of the immense disbursement. Such a service cannot be expected of a Board constituted as the present one is. Serving without pay, they can hold only occasional meetings; engaged in their own business, they cannot always be found when wanted, and can give only a divided mind to the city's interests, and but dribblets of their time. Would any sagacious individual, or private corporation, adopt such a system of management and supervision for a property costing \$17,000,000. The members of the present Board are as fully aware as any of us of the unsatisfactory character of the present system, and have communicated to me, in a formal resolve, their opinion that there should be a Water Board constituted as I have recommended. The expense of a paid commission would be utterly insignificant in view of the vast pecuniary interests at stake."

The above portion of the address was referred by the Council to the Joint Standing Committee on Water, who reported as follows:—

[City Doc. No. 26.]

"IN COMMON COUNCIL, February 10, 1876.

"The Joint Standing Committee on Water, to whom was referred so much of the Mayor's address as relates to the reorganization of the Water Department, having carefully considered the subject, would respectfully report as follows:—

"While some members of the committee are opposed to the radical changes in relation to placing nearly every department of the City Government under a paid commission, as proposed by the new charter now under consideration, yet the committee unanimously recognize the fact that the onerous and highly responsible duties which naturally devolve upon the persons who have charge of the Water Department should be discharged by a paid Board, who will give their whole time, undivided attention and energy to those duties.

"When the magnitude of the work in connection with the additional supply of water from Sudbury river, involving an expense of nearly five millions of dollars, the number and amounts of the contracts, and the very important subject of land and mill damages, are considered, your committee submit that there can no longer be a question as to the expediency of immediately placing the Water Department in strong, responsible and competent hands. The construction of the proposed sewer in the Mystic valley will also prove a large undertaking, and careful and skilful management will be required for its satisfactory completion. The change which the committee propose meets with the approval of both the Cochituate and Mystic Water Boards.

"Without further going into the merits of this question, which has been so fully discussed by the City Government of 1874 and 1875, your committee would respectfully recommend the passage of the accompanying ordinance, which provides for the union of the Cochituate and Mystic Water Boards under a paid Board, to consist of three persons, as authorized by Chap. 80 of the Acts of the Legislature of 1875.

"The ordinance is substantially the same as that recommended by the Committee on Water, on the 16th of April, 1874, which was carefully prepared, and which guards and limits the powers vested in the Board, and enables the City Council, at all times, to exercise a wise and careful supervision over their action.

"Certain amendments have been made in the section relating to the receiving of bids and the letting of contracts, in order to conform to the terms and forms of contracts now existing, for the construction of the works necessary for the introduction of the Sudbury-river supply, made by the Cochituate Water Board, acting under the authority of the City Council.

"It is provided that the confirmation by the City Council of each member of the Water Board, appointed by the Mayor, shall be decided by vote taken by ballot.

"If the proposed ordinance meets with the approval of the City Council, the powers and duties now exercised by the Cochituate and Mystic Water Boards will terminate on the 30th of April, the close of the present financial year, except that it is provided that each Board shall submit its annual report for the year ending on said date, as required by existing ordinances.

"Respectfully submitted,

S. B. STEBBINS,
JOHN T. CLARK,
A. O. BIGELOW,
JOHN SWEETSER,
GEORGE A. SHAW,
MARCELLUS DAY,
JOHN W. FRASER,
RICHARD BEECHING,

Committee on Water."

The ordinance, which is omitted, as it failed to pass, was referred, Feb. 21st, to the Committee on Ordinances, with a proposed amendment, constituting one Alderman, one Councilman, and three members at large, said Water Board.

Finally, the Joint Standing Committee on Ordinances reported, Feb. 24th, 1876, a new draft of an ordinance (City Doc. No. 28), which passed both branches of the government, and was approved by the Mayor March 22d, 1876.

See *Part Fourth* for ordinance.

The members of the new Water Board have not yet [June 15th] been appointed, as the City Council have not fixed the salaries.

[On July 6th the Mayor appointed Timothy T. Sawyer, Leonard R. Cutter, and Albert Stanwood members of the Boston Water Board for the terms of three years, two years, and one year, respectively. On July 24th these nominations were confirmed by the City Council, and on July 31st the organization of the Boston Water Board was completed by the choice of Timothy T. Sawyer as Chairman and Walter E. Swan as Clerk. The last meetings of the Cochrane and Mystic Water Boards were held on the same day, and the whole property of the Water Works transferred to the new Board.]

PART SECOND.

HISTORY AND DESCRIPTION OF THE WORKS FOR A
NEW SUPPLY OF WATER.

1871.

NEW SUPPLY OF WATER.

Although it had been apparent for some years to those intimately acquainted with the capacity of the existing works, that the water-shed of Lake Cochituate was insufficient to meet the wants of the city, it was not until 1871 that active steps were taken by the City Government to seek a new source of supply. The difficulties experienced by the Water Board in meeting the growing demands of the city, and the failure of the lake during the droughts of 1870-71 and 1874, have been described in other portions of this work, particularly under the heads of "Pumping at the Lake," and "Temporary Supply of Water." It will be sufficient to restate that the capacity of the Cochituate system having been taxed to its utmost, a general alarm was felt by all citizens lest the supply of water should be curtailed, or cut off altogether. On January 23d, 1871, the Joint Standing Committee on Water of the City Council were requested to report on "the feasibility of enlarging the source of supply," and on August 14th the Cochituate Water Board was asked "to report if the lake was sufficient as a source of supply, and if not, what measures had best be taken to increase the same."

In September following, the Board informed the Council that they were of the opinion "that Lake Cochituate will not be sufficient for the supply of the city for any great length of time, and we believe it to be for the interests of the city to ascertain where an additional source can be obtained, and for that purpose they would ask for an appropriation of ten thousand dollars, for the purpose of defraying the expense of making surveys of various sources of supply."

October 20th. The following order was approved by the Mayor:—

"*Ordered*, That the Cochituate Water Board be authorized to make surveys and inquiries for the purpose of ascertaining the expense of procuring an additional supply of pure water for the City of Boston, and that the sum of ten thousand dollars be transferred from the reserved fund to meet the expense of making such surveys and inquiries."

Immediately after the passage of this order, the Board took preliminary steps towards making a thorough investigation as to the best source of supply, which resulted, November 15th, in the employment of Mr. Joseph P. Davis as their Engineer.

On November 22d Mr. Davis entered upon his duties. He was instructed to examine all the feasible sources within fifty miles of the city, and to have in view, —

"*First.* — The quality or purity of the water.

"*Second.* — The probable growth of the city, and its future wants.

"*Third.* — The cost of the requisite works for storing, purifying, and conveying the water, either to the Chestnut Hill or Brookline reservoir.

"*Fourth.* — The immediate need of a temporary additional supply to avert the threatened deficiency of the coming season."

On December 12th an order was approved, authorizing the Mayor to petition the Legislature for an act to take any source of supply within fifty miles of Boston.

During the whole of this year the citizens were enjoined to limit their consumption of water to the smallest possible amount. Stringent rules were made by the Board against the waste of water, and prohibiting the use of hand hose.

1872.

The Mayor, in his annual address, called particular notice to the low state of the lake, and urged on all consumers of water the importance of strict economy in its use. On February 13, 1872, Mr. J. P. Davis submitted a verbal report to the Water Board, on the quantity and quality of water from various sources, together with estimates; in consequence of which the Board voted at this meeting to ask for authority to take water from either the Charles or the Sudbury river. During the hearing before the Legislative Committee a great deal of opposition was met with, and these two sources of supply, incorporated in the original bill, were changed to the Sudbury alone, which the committee accepted. (See City Document, No. 61, 1872.)

On April 8th the Governor signed the act for an additional supply from Sudbury river and Farm pond, in Framingham. (See *Part Fourth* for act.)

After the passage of this bill, Mr. Davis was instructed to proceed at once with the temporary connection between the Sudbury river and Lake Cochituate, \$100,000 having been appropriated by the City Council, April 12th, for carrying on the work. (See "Temporary Supply" for description.)

On April 15th the Water Board voted to create a Committee on New Supply, and the President, Mr. Charles H. Allen, with Messrs. Bradlee and Haven, were appointed.

1873.

On February 6th, Mr. J. P. Davis' report on an additional supply of water, was received by the Board. (See City Document No. 29.)

We make the following extracts : —

“ COCHITUATE WATER BOARD OFFICE.

“ BOSTON, March 13, 1873.

“ *To the City Council : —*

“ Immediately after the acceptance of the Legislative Act, authorizing the City of Boston to receive an additional supply of water from Sudbury river, the Cochituate Water Board gave such attention to the subject as would secure temporary advantages from this source.

“ This being accomplished, the engineer employed upon that work (our present efficient City Engineer) was authorized to make such surveys and estimates as would lead to an intelligent decision upon the most feasible route for the construction of a new and independent conduit, which will give us the permanent advantages which the Sudbury river is so abundantly able to furnish.

“ These surveys being made, the Board sent for Mr. E. S. Chesbrough, of Chicago (the accomplished engineer under whose direction our present works were constructed), to examine the proposed route, and pass his judgment upon the plans.

“ Mr. Chesbrough cheerfully responded to our invitation, and spent several days upon the work.

“ The extended report of the engineer, and the comments of Mr. Chesbrough, are submitted herewith.

“ The rapid growth of our city, and the certain prospects of unprecedented increase in the immediate future, render it unnecessary to make any arguments in favor of the object.

“ This Board would ask the early attention of the City Council to the consideration of the subject, and suggest that an appropriation of 500,000 dollars be made, and the work commenced without delay.

“ CHARLES H. ALLEN,

JOHN A. HAVEN,

ALEX. WADSWORTH,

“ *Committee on Additional Supply of Water.*”

In the engineer's report attention is called to “ The need of an additional supply.”

To “ The sources examined,” viz. : —

“ Sudbury river, Framingham.

“ Charles river, Newton.

“ Assabet river, Marlborough.

{ “ Lake Quinsigamond, Worcester.

{ “ Nashua river, Boylston.

"Merrimac river, Lowell.

"Mystic lake, Medford.

"Ipswich and Saugus rivers, Essex Co.

"Neponset river, Dorchester.

"Assawampset, Long, Great and Little Quittacus ponds in Middleborough, and Monponset and other ponds in Halifax, Hanson and Pembroke.

"Taunton river, Bridgewater.

"Flax and other ponds in Lynn.

"Nagog pond, in Acton and Littleton.

"The available yield of the Sudbury river," which is placed at 40,000,000 gallons per day.

"The quality of the water.

"Scheme of works.

"Necessity of soon beginning construction.

"ESTIMATE.

"The estimated cost of works as now designed, excluding interest upon money during construction, and water damages (for reckoning the value of which there seems to be no well-determined basis), is as follows:—

Three storage basins, dams, etc.	\$495,000 00
Wooden pipes connecting dams	70,200 00
Work at Farm pond	8,500 00
Conduit, including gate-chambers, waste-weirs, culverts, siphons with one line of 48-inch pipes, inlet chambers, tunnels, etc.	3,497,300 00
Pipe in Bradlee basin to connect the conduit with reser- voir outlet chamber	72,318 00
Land damages, including mill property taken	375,000 00
Superintendence	270,000 00
Total,	<u>\$4,788,318 00</u>

"In the quantities upon which the above estimate is based, and the prices applied to them, liberal allowances for contingencies have been made, and it is believed that the total of the estimate will fully cover the cost of the works, excepting only the two items mentioned. It is, moreover, probable that before and during construction changes will be made in designs, or location, or materials to be used, that may effect a considerable saving."

In the Appendix will be found a report on the various sources available to Boston, mentioned above, viz. : the Assabet river, Lake Quinsigamond, etc., etc.

The report of the consulting engineer we give in full : —

“REPORT OF CONSULTING ENGINEER.

“CHICAGO, Feb. 4, 1873.

“CHAS. H. ALLEN, Esq., *President Cookinuate Water Board, Boston, Mass.* : —

“SIR, — In compliance with your request of November 25, 1872, I have, in company with Mr. Davis, your engineer, carefully gone over his report relative to the future supply of water, for the City of Boston, and have visited the important points on the line of aqueduct he recommends.

“Before recommending any plan, Mr. Davis shows the necessity of an additional supply, and the danger of attempting to make the present aqueduct deliver more than it does now. Estimates of future population are necessarily uncertain, but the past history of Boston and its present and increasing importance, as one of the great commercial centres of our country, make evident that it should expect not only to experience a similar increase of wealth and population to that of the other great centres, but also to have to provide for the wants which will come with that increase, among the principal of which is an abundant supply of pure water.

“The supply has already proved quite inadequate at times, and is still more likely to do so hereafter. Boston cannot reasonably hope to avoid the usual obligations of large cities in this respect. If governed by my own observation and experience in this matter, I should increase Mr. Davis' estimate of the probable future quantity of water required, rather than diminish it.

“With reference to the capacity of the present aqueduct to deliver more than it now does, by being put under greater pressure, I know that it was originally designed for a covered canal, and never intended to be subjected to pressure, or even filled to the top. Experience shows that the structure ought not to be subjected to any greater strain than those hitherto made, or the consequences may be disastrous.

“The methods taken by Mr. Davis to ascertain the available quantity, in the driest seasons, of the different drainage basins within fifty miles of Boston, are to me entirely satisfactory. His approximate estimates of the probable cost of obtaining such quantities, though not based upon actual surveys and elaborate plans of his own, are based upon reliable information as to distances and general character of each district, and thus furnish a safe means of comparison, especially where there are marked differences, and more particularly where it is known that a rejected source could not cost less than a given sum.

“Taking into account the results of Mr. Davis' estimates, and the probable wants of the city during the next thirty years, — not to say fifty, — there appear to be but two sources of supply, the Sudbury river and the Charles river (and possibly the Mystic river) drainage areas, that should be taken into further consideration. Judging the future of Boston by the past, it is not probable that the Mystic-river basin would be sufficient to supply the towns that would naturally draw from it, and at the same time the increasing demands of Boston, long enough to make it an object to construct the necessary works, even if there were no legislative objection to the plan, or no present or prospective difficulty of keeping the water as pure as that to be derived from the other sources. Other things being equal, the nearer a source of supply is to a large city, the more likely it is to be corrupted; for were it possible to prevent all im-

purities from being thrown into it, or upon the surface of the ground by men, the impurities of the atmosphere will be precipitated upon it by rain and in other ways, as may easily be seen upon the surface of snow a few days after it has fallen. It seems to me, therefore, that the only choice is between the Sudbury river and the Charles river schemes.

"The Sudbury-river scheme has been very carefully elaborated, and its probable cost satisfactorily estimated. I have scrutinized the details of the plan, and the estimates both for the aqueduct and the gathering basins, and with the exception of two or three minor details do not see room for improvement. Even in these, such as the crossing of Charles river, either by continuing the aqueduct at grade, or using syphon pipes to save expense, or a slight change of line in other places, I am not prepared to say what should be done, but would recommend further consideration. Here, I would say, there had not been time enough to work out thoroughly all the details of the scheme, in addition to so extensive an investigation of the essential facts connected with the other drainage areas.

"I am fully satisfied that such an aqueduct as Mr. Davis recommends may be safely relied upon to deliver 70,000,000 gallons in twenty-four hours.

"The Charles-river scheme has not been elaborated in detail, but enough is positively known to prove that it could be made to furnish even more water than the Sudbury river, and at a considerably less first cost. This being so, it seems to me a very important question, why should the larger expenditure be made, supposing all legislative objections to be removed?

"If the water of Charles river should require filtering to make it suitable for important manufacturing purposes, or agreeable for domestic uses, this would be a very serious objection to it, not only on account of the additional expense thus rendered necessary, but on account of the difficulties attending such a process on a large scale in very cold weather. I have from personal knowledge no means of deciding this question to my own satisfaction, but if the weight of testimony shows that the water of Charles river is decidedly inferior in quality to that of Sudbury river, then you would be fully justified in adopting the more costly scheme.

"In connection with the above objection, two others, which could have no preponderating influence without it, might be mentioned; one is the greater proximity to the city of a large portion of the Charles-river drainage area, and its consequently greater liability to future pollution; and the other is the greater possibility—though very slight probability—of the pumping-works failing to furnish a supply. Two of the cities of this country, Buffalo and Jersey City, both dependent upon pumping-works, have been out of water for a day or so at a time. A foreign war, though not accompanied by an actual invasion, might, like that of 1812, have so long an embargo as to make it impossible to obtain a sufficient quantity of fuel. There are other possible dangers of cutting off the supply of fuel, such as strikes among the miners, and epidemics.

"The necessity of providing some means of cleansing or repairing the lower division of the Chestnut Hill reservoir, without limiting the supply for the city to the Brookline reservoir, is becoming greater every year, and should be attended to without delay. Mr. Davis' plans for effecting this purpose seem to me to be judicious and advisable.

"Respectfully submitted,

"E. S. CHESBROUGH."

The request of the Board for an appropriation was complied with by the Council. The following is the vote:—

"*Ordered*, That the Treasurer be authorized to borrow, under the direction of the Committee on Finance, the sum of Five Hundred Thousand Dollars, to be expended under the direction of the Cochituate Water Board in furnishing an additional supply of pure water from Sudbury river.

"March 31. Passed. Yeas 12, nays, none.

"Sent down for concurrence, April 10, 1873.

"Came up concurred. Yeas, 51; nays, none.

"Approved by the Mayor, April 11, 1873."

On April 12th the Water Board voted that the City Engineer be instructed to proceed forthwith in the construction of the new conduit, in consonance with the plans presented in his recent report; and that he, with the concurrence of the Committee on "Additional Supply of Water," be authorized to employ such assistants as may be necessary for a thorough examination and location of the line, and take such other steps as may be needed, preparatory to its early construction.

In accordance with this order, Mr. J. P. Davis engaged the services of a number of Assistant Engineers in May, and placed them under the charge of Mr. A. Fteley, an accomplished hydraulic engineer, by whom the plans, locations, etc., have been made, under the general directions of Mr. Davis, the Chief Engineer.

June 12th. The Committee on New Supply reported that they had examined the routes of the new conduit, as proposed by the City Engineer, from Chestnut Hill reservoir as far as Newton Centre, and had voted unanimously to adopt the Beacon-street route, in the town of Newton, and that they had instructed the City Engineer to prepare specifications and advertise for bids for the execution of the work on the tunnel at as early a day as practicable.

The report was accepted.

The tunnel referred to is at the easterly extremity of the route, and is nearly a mile in length, built through rock. [See Description further on.]

July 3d. The Board voted to adopt the "Bridge Line," on Charles river, for the new aqueduct.

The question had been between a bridge and a siphon for the crossing of the river.

August 7th. The bids for excavating a tunnel and building a portion of a conduit, in connection with the new supply, were publicly opened and read by the clerk, at the time appointed. Messrs. Lobdell and Parker * were declared the successful bidders.†

* By a subsequent vote of the Board the name of Mr. Henry W. Phelps was substituted for that of Mr. Parker, he having signified a desire to withdraw from the contract.

† The amount was \$389,380.

This was the tunnel referred to above. As it was the most difficult and expensive section of the conduit, and one requiring a longer time to execute than any other, a beginning was made at an early day, in order that it might be completed with the rest of the aqueduct. Work on this tunnel was prosecuted with vigor by the contractors during the whole time that the matter of different sources of supply was under discussion in the Council.

Oct. 9th. The Committee on New Supply were authorized to purchase such land in Framingham and vicinity for purpose of a storage-basin, as they may deem expedient, not exceeding however \$10,000 in value.

Oct. 13th. The Water Board voted that the City Engineer be instructed to proceed immediately with the necessary surveys for the purpose of obtaining the description of lands required for a storage-basin in Framingham and Ashland. Extensive surveys were at once made in the valley of the Sudbury for the above purpose.

Oct. 18th. The Water Board voted that the City Solicitor be requested to prepare the necessary papers in accordance with the description furnished by the engineer, for the purpose of seizing land in the town of Ashland and the whole of Sudbury river.

While engaged in this matter the City Solicitor gave it as his opinion that the Board had not obtained the requisite authority from the City Council to proceed to seize lands, water rights, etc.

Accordingly an order was introduced at once, and passed the Board of Aldermen, Oct. 20th, giving the Board the required authority; but the order failed to pass the Common Council, who referred it to the next Council.

"Charlestown, with its water supply, had recently been annexed by vote of the people, and the strong argument urged in favor of annexation had been the use of the Mystic water for the partial supply of Boston, and the consequent postponement for a number of years of the large expenditure required for the building of the Sudbury-river works, as projected. Under the circumstances, it was thought best by the City Council, before granting the power asked for, to have made a more thorough investigation of the capacity and purity of the water of the Mystic valley, and accordingly the following order was passed" and approved, Oct. 31:—

"*Ordered*, That the Cochituate Water Board be requested to furnish information to the City Council, as early as practicable, upon the following points, viz.: the present condition of the water of Mystic pond, as regards quantity and purity; the approximate cost of obtaining a

supply from said pond for the City of Boston; the objections, if any, to relying upon the same as a source of supply; the condition of the present conduit from Lake Cochituate as regards capacity and safety, and the changes needed to prevent any waste of the present supply; the expense of obtaining said information to be charged to the appropriation for furnishing an additional supply of water."

On November 1st the Board voted, that in accordance with the request of the City Engineer, one or more prominent hydraulic engineers be employed to make the investigations and report required by the above order.

Messrs. James B. Francis and James P. Kirkwood were appointed.

Nov. 11th, the following order was approved:—

"*Ordered*, That the Cochituate Water Board be requested to report to the City Council the condition of the water of Farm pond, as regards its purity, and to furnish an analysis of the same."

Nov. 12th. The Board referred the matter to the Committee on New Supply.

1874.

January 7th, 1874, the Mystic and Farm pond reports were made. (See City Document No. 134, 1873.)

We make the following extracts:—

"Report of the Cochituate Water Board, in Reply to an Order of the City Council (Passed Oct. 31st, 1872) Relating to the Available Quantity and Purity of the Mystic Water and to Other Matters Connected with an Additional Supply for Boston."

OFFICE OF THE COCHITUATE WATER BOARD,

BOSTON, January 7th, 1874.

"To the City Council of the City of Boston:—

"In compliance with the order of the City Council of Oct. 27, 1873, requesting the Cochituate Water Board to investigate and report upon the following matters:— 'The present condition of water in Mystic pond, as regards quantity and purity; the approximate cost of obtaining a supply from said pond for the City of Boston; the objections, if any, to relying upon the same as a source of supply; the condition of the present conduit from Lake Cochituate, as regards capacity and safety; and the changes needed to prevent any waste of the present supply;'— the Board asks leave to reply:—

"That its attention was called to the Mystic pond as a source of supply for this city some two years since by their engineer (See City Doc. No. 29, 1873), but after due consideration it was dismissed from the list of practicable sources which the Water Board thought its duty to recommend to the City Government; but, after the receipt of the above order of inquiry, and recognizing the wide differences of opinion existing in the community as to the quality of the water as well as to the capacity of the Mystic

basin as a source of *permanent* supply for the City of Boston, the Board, as a matter of justice to itself and its engineer, has thought it judicious and proper to have the whole subject investigated independently, by thoroughly competent persons, so that, after the investigations were closed and the facts presented, the questions should be definitely settled in every reasonable mind. With these views, the services of two eminent hydraulic engineers, Mr. James P. Kirkwood, of Brooklyn, N. Y., and Mr. James B. Francis, of Lowell, Mass., were secured as an Engineering Commission, and the Board was equally fortunate in securing Prof. E. N. Horsford, of Cambridge, to investigate as to the purity of the water. All these investigations, and the results, will be found in their reports, in the succeeding pages of this document, and are worthy of the careful attention of the City Council, and of citizens generally. The facts given with regard to the Mystic basin are in close approximation to the information that was already in possession of the Board, from the report of its engineer (the present City Engineer), and stated in general terms in the City Document above referred to, and show not only that the extravagant claims made for this basin as a source of permanent supply were, in a large degree, unfounded, but that an imperative duty exists for the city to take the most effectual means for securing that supply from some other and more practicable source, for its rapidly increasing territory, population, and industries at the earliest moment.

“ COMBINED SUPPLY FROM THE COCHITUATE AND MYSTIC.

“ The report of Messrs. Kirkwood and Francis states, that by utilizing (at an expense of \$994,562 for storage reservoirs) all the available storage capacity of the Mystic basin, including the lower Mystic lake, a total supply of 18,000,000 gallons daily may be secured, and that a more moderate expenditure for reservoirs will provide a supply from which a surplus of about 5,000,000 gallons may be applied to the use of Boston, until 1880 or thereabouts, when the increasing demands of Charlestown and East Boston, and the towns depending upon the Mystic works, will begin to curtail it. It is also stated, that the Cochituate conduit should not be relied on ‘to convey more than 17,000,000 gallons in any one day.’ These statements should be considered together, in computing the total supply available to Boston for the next few years.

“ The consumption in Boston during 1873 was about 18,000,000 gallons daily, and largely in excess of the previous year, due partly to a reckless use of hand-hose, leakage in the burnt district, and an increased head in portions of the city, as well as to the increased number of water-takers. The consumption is very unequal in different months, and to maintain the supply during the summer months it was found necessary to use the conduit under a pressure that would give a flow of over 20,000,000 gallons in twenty-four hours, and even then the reservoirs were drawn down to a point that reduced materially the water held in reserve to supply the city in case of accident to the conduit. If the maximum flow of the conduit is to be limited at 17,000,000 gallons in twenty-four hours, the supply will not on an average much, if at all, exceed 15,000,000 gallons daily. To operate the Cochituate Works *safely*, an additional supply of 3,000,000 gallons daily is required at once; and the supply which can be safely obtained from the Cochituate Works, combined with that which may be secured from the Mystic (some two years hence), will give an excess of only 2,000,000 gallons daily, above the use of the past year, to meet the future increase in consumption, which will follow from increase of population, by natural growth and by annexation. By using all the storage area offered by the Mystic basin, this excess may be increased to some four or five millions, an amount which, at the rate of increase in water-takers that has ruled for the past few years, will be absorbed in four or five seasons.

“ If the conduit is to be operated as it was found necessary to operate it the past year,

—in a manner which, it is proper to say, the Water Board and its officers consider decidedly unsafe, — the excess will be further increased by about three millions of gallons. This is upon the supposition that the Cochituate water-shed will yield a supply of 18,000,000 gallons daily; but the fact is, it cannot be relied upon to do so. The following table exhibits the total quantities of water, stated in daily averages, that entered the lake from its water-shed during various years, and of which in some years a large portion was necessarily wasted over the dam during floods: —

Year.	Gallons per day.	Year.	Gallons per day.
1853.	17,873,800.	1858.	17,759,013.
1860.	17,714,065.	1864.	15,370,152.
1866.	14,265,280.	1871.	18,197,800.

“The yield of the Cochituate water-shed in a season of extreme drought has been estimated by the City Engineer, Mr. Jos. P. Davis, at 12,000,000 gallons daily; but, as seen above, in 1871, which cannot be considered such a season, it actually was only 18,197,800 gallons. Add to this the 5,000,000 gallons that may be taken from the Mystic, and there is 18,000,000 gallons, — just equal to the consumption of the past year, 1873. To state the case plainly — and it does seem that the time has come to so state it — this city will be dependent upon good fortune, that is, upon heavy rains and freedom from accident to the works, for a full supply of water during the next few years, even if the Mystic be drawn upon, unless an auxiliary supply is taken from the Sudbury river, as in 1872. As matters now stand, the city has no rights in the Sudbury river, and would unquestionably be prevented, by the mill-owners and others interested, from again drawing from it unless the river is legally seized under the Act of the Legislature authorizing the taking. If it be decided to abandon the Sudbury-river project, the city will be forced to rely upon the Cochituate and Mystic districts, from which, by an expenditure of some one and a half millions of dollars upon the latter, in two years a total daily supply of about 22,000,000 gallons can be furnished; *provided* that the rainfall is favorable, and the Cochituate conduit is operated under objectionable pressure during the months of greatest consumption.

“THE SUDBURY RIVER.

“During the early months of 1872, while the pumping-engines were at work in Lake Cochituate, in consequence of the unprecedentedly low state of the water, application was made by the city to the Legislature for power to take water from an independent source of supply; and the Water Board was informed by the legislative committee that it must limit itself to two sources, after a careful study and survey of the whole question. A pretty thorough examination had been hurriedly made of the different available water districts within reasonable distance from the city, including the Ipswich and Saugus rivers at the north, the great lakes of the Middleborough district at the south, and the Merrimac river at the northwest. All these were rejected, however, either for their large cost, impurity of water, difficulty of connection with the present system of works, want of storage capacity, or insufficient amount of water for the needs of the distant future. The only course, therefore, was to look to the west, where were found the Charles, Sudbury, Assabet and Nashua rivers and Lake Quinsigamond, which, combined, would give a daily supply of 220,000,000 gallons, and all of which could be brought to Chestnut-Hill reservoir in the same conduit. The Water Board selected the Charles and Sudbury rivers; but during the hearing before the legislative committee a strong and decided opposition was made to the taking of the Charles river,

except upon such conditions and restrictions as were entirely inadmissible; and therefore, upon the promise of the committee to report a favorable bill for the Sudbury, the Charles was dropped, and a bill for the Sudbury was reported and passed by the Legislature. Doubtless the facility with which the water of the river could be turned into Lake Cochituate to supply a pressing temporary want in that basin had some considerable weight in the selection; but careful study and survey of its capabilities as a source of permanent supply revealed facts of a very favorable character. These were: The large amount and good quality of the water; its excellent storage facilities and easy control; comparatively moderate cost of construction, and shortness of the conduit line to Chestnut-Hill reservoir, the great point of distribution; and the comparative present and prospective freedom from pollution of the water-shed. Its combined value in all these essentials is such that the Water Board has seen no reason to regret its selection or doubt the wisdom of the choice. The rapidity with which its waters can be turned into the lake has already been proved at a time of some considerable public peril.

"The Sudbury, with its ample storage basins, in a season of drouth will yield a minimum supply of 40,000,000 gallons daily, and in favorable seasons a supply of 50,000,000 gallons or more; should occasion demand in the future, it can be easily connected with the Assabet river, from which nearly an equal amount can be drawn, and the practicability of its connection with the other water districts named above is an equally assured fact. The connection with the Charles river would be by pumping-works at South Natick; all the others by gravitation. In the Sudbury-river scheme of works, not only has the needs of the immediate present been duly considered, but the future has been amply cared for.

"Efforts seem to have been made to prejudice the Sudbury-river scheme, by misrepresenting its cost, and the time required for its construction. It has been claimed that it will cost between twelve and fifteen millions of dollars, and that it cannot be completed short of ten or twelve years' time.

"Those making these misrepresentations entirely ignore the careful and exhaustive surveys, and the liberal estimates founded upon them by our able and experienced engineers. The Water Board has no hesitation in saying there is not the slightest foundation for such statements; that there is no reason for distrusting the professional skill of, or the facts and estimates given by, the engineers, in their report as to the cost or the time required for construction; most certainly not upon the reckless statements of those having no practical experience in engineering works. So far as the amount of water or mill-damages to be paid is concerned, the Board can only say that this matter will be determined before a Massachusetts court and jury, and upon competent evidence as to the real amount of damage caused by diverting the water of the river; it has no fear but that the verdict will be an equitable one, and the damages not excessive. But it must not be forgotten that the City of Boston cannot take water from any practicable source without paying for it; and it is not at all probable that the cost will be larger, in proportion, for the Sudbury river, than for water taken from any other source.

"When the present Cochituate conduit was constructed, it was generally considered that the city had secured an ample water supply for the next fifty years at least. But a little more than one-half of that period has passed, with the results which are now under consideration. The lesson is a very useful one, not only to the City Government, but to all concerned. After mature deliberation upon all the numerous questions involved in the general subject of securing a permanent and ample supply of water for domestic, fire, manufacturing, and other uses for a rapidly growing community like this, the Water Board finds ample reasons for again recommending the most

energetic action for the construction and early completion of the Sudbury-river supply for the City of Boston. The adoption of any policy which shall restrict the supply of water for all legitimate uses will be a mistaken and unfortunate one; and this will apply with great force to the territory recently annexed and that hereafter to be annexed, and with still greater force to the numerous manufacturing industries that are springing up in and near the city limits. The fear of an insufficient supply would tend to restrict and dwarf a great many industrial establishments in a very large degree, and possibly lead to their location elsewhere. The Water Board feels that a great and growing city like this cannot afford to endanger its progressive prosperity by failure to take the proper action to secure its continuance.

" FLAX POND.

"In passing, it may be well to take some notice of the persistent efforts which have been made through the public press (probably by interested parties) to induce the taking of Flax pond, in Lynn, as a source of supplementary supply for this city. This source had already been examined and rejected, because of its small area of watershed; the pollution of the water by the objectionable refuse of manufacturing establishments; the large cost of construction of the works with reference to the amount of water to be obtained; the cost and difficulty of diverting the objectionable sewerage on its shores; and the uncertain amount of damages to be paid for diverting its waters. Subsequently, however, it was deemed advisable to refer the whole question of Flax pond to the engineers, Messrs. Kirkwood and Francis; and they have reported (see pages 24-27) that, in their opinion, it is inadvisable to add it to the present city supply; and for reasons that are nearly identical with those that first led to its rejection by this Board.

" LEAKS AND WASTE.

"The questions of waste and leakage have received more than an ordinary degree of attention during the past year. The large consumption, ruling nearly through the whole year, is not only unexpected, but somewhat alarming. The Board had hoped by a thorough search for leaks both in the street-mains and house-service to reduce the consumption below that of 1872; or, at least, place the works in a condition that would result in an important saving during the present year. While many hundreds of defective fittings that were causing a large waste have been discovered and repaired, no leaks of consequence have been found in the street-mains; and, though the saving that has been effected by the repairs made must be considerable, the consumption of the past two or three months shows that not much relief can be counted upon from stopping leaks.

"The examination that has been made, however, has furnished additional evidence of the great *waste* that results from the use of certain classes of fittings, more particularly the hopper-closet. Attention has been frequently called to this matter in former reports, but no action has been taken by the City Council. It is to be hoped that now, when it is of the utmost importance to the city that every gallon of water it can furnish shall be usefully applied, the necessary powers will be given the Water Board to control, as far as practicable, the harmful waste that is now going on through improper fittings. In many instances, as has been proved by meter measurements, the owners of a single hopper-closet are using, or rather wasting, at a cost to them of only *five dollars* per annum, as much water as the manufacturer uses whose yearly water-rates amounts to some hundreds of dollars. This great waste subserves no sanitary or other useful purpose, and should at once be repressed by the most vigorous measures. Even if the saving of water were not so important, the injustice of such unequal taxation would con-

demn the present system. This very important matter is more fully discussed in the annexed report of Mr. Wm. F. Davis, the Water Registrar, to which you are referred for more detailed statements.

“ ANALYSES OF THE WATER OF FARM POND, SUDBURY RIVER, AND LAKE
COCHITUATE.

“ An order was passed by the City Council, November 10th, 1873, requesting the Water Board to have made a chemical analysis of the waters of Farm pond. In complying with the request, the Board has also had analyzed a sample taken from Sudbury river, another from its most important tributary, Stony brook, and two from Lake Cochituate.

“ The analyses, the results of which are given in the following table, have been made by Messrs. Merrick and Gray, analytical chemists, who had no knowledge of where the samples were taken :—

	A Stony brook.	B Sudbury river.	C. Farm pond. Surface.	D Farm pond. 7 ft. deep.	E Lake near gate-house.	F Lake. Southern division.
	<i>Grains in U. S. gal.</i>	<i>Grains in U. S. gal.</i>	<i>Grains in U. S. gal.</i>	<i>Grains in U. S. gal.</i>	<i>Grains in U. S. gal.</i>	<i>Grains in U. S. gal.</i>
Suspended matter	0.48	0.31	0.23	0.15	0.24	0.40
Inorganic	2.10	2.39	1.98	1.75	1.87	2.25
Organic	1.69	1.80	1.16	0.99	1.10	1.92
Total	4.27	4.50	3.37	2.89	3.21	4.58
Silica, oxide iron, alumina, etc. .	0.73	0.70	0.54	0.38	0.40	0.70
Chlorine as chloride sodium . . .	0.35	0.40	0.35	0.35	0.33	0.30
Albuminoid ammonia	0.0147	0.0139	0.016	0.013	0.012	0.015
Ammonia	0.003	0.004	0.004	0.0041	0.005	0.004
	0.0177	0.0179	0.02	0.0171	0.017	0.019

“ All the samples were taken Nov. 7th, 1873.

“ Sample A was taken from Stony brook, about 500 feet above the proposed location of Dam III.

“ Sample B was taken from Sudbury river, about 200 feet above the wooden dam built by the city in 1872.

“ Sample C was taken from the surface of Farm pond, about 400 feet north of the proposed location of the gate-house for the new conduit.

Sample D was taken at the same point in Farm pond, but 7 feet below the surface.

Sample E was taken from Lake Cochituate, near the gate-house of the conduit.

Sample F was taken from the southern division of Lake Cochituate, at the culvert under the turnpike, and near where Beaver Dam Brook (the chief tributary of the lake) discharges.

“ Mr. Merrick makes the following remarks :—

" Sample A.

" 'This water was yellowish, inodorous, tasteless, with some slight flocculent deposit after standing. The unconcentrated water gave indications of ammonia by the Nessler test.'

" Sample B.

" 'This sample was yellowish, tasteless, inodorous, with some flocculent deposit on standing. It gave slight indications of free ammonia by the Nessler test.'

" Sample C.

" 'This sample was nearly colorless, tasteless, and inodorous, with a very slight flocculent deposit after standing. It gave exceedingly faint indications of ammonia, unconcentrated.'

" Sample D.

" 'This sample was colorless, or nearly so, inodorous, and giving a trifling deposit on standing. It gave very faint indications of ammonia.'

" Sample E.

" 'Nearly colorless, with faint, yellowish tint, inodorous; some deposit of reddish flakes. It gave exceedingly faint indications of ammonia.'

" Sample F.

" 'This water was yellow, inodorous, and tasteless, with considerable flocculent deposit. The unconcentrated water gave indications of the presence of ammonia by the Nessler test.'

" The analyses show Farm-pond water to be very pure and free from objectionable qualities of all kinds. There had been no flow into the pond, except surface drainage, for over a year before the samples were taken, and the outflow had been very slight — just sufficient to keep the pond at a proper level.

" The two samples from Cochituate were analyzed to show the effect of storing and exposure to the air in purifying the water. Sample F may be regarded as a fair (favorable rather than otherwise) specimen of the quality of the water from the Cochituate water-shed as it enters the lake; sample E — a fair specimen of the same water after it has reached the entrance to the conduit.

" EFFECTS OF STORAGE ON WATER.

" It will be noticed, by consulting the table, that the effect of storing has been to greatly improve the quality of the waters, and to notably decrease the amount of organic matter, which is the impurity the most to be feared; in fact, the inorganic impurities may be said to be perfectly harmless.

" This beneficial effect of storing and exposure is more strongly shown in the samples of water from the Mystic analyzed by Professor Horsford, as will be seen by consulting his report. The waters tributary to the Mystic are vastly more charged with impurities, both mineral and organic, than those of the Cochituate or Sudbury water-shed; yet, during the exposure to the air to which they are subjected on entering and passing through the Mystic lake, they become purified and rendered fit for domestic use.

" The samples from the Sudbury valley were taken when the river was swollen by previous rains, and the water more than usually charged with organic or vegetable matter; yet the analyses show very favorably for the purity of this water when compared with that of the Cochituate or Mystic districts before it enters the lakes.

"It can be safely said that the Sudbury water, after having been stored, and by the time it reaches the consumer, flowing, as it will, exposed to the air in Farm pond and 17 miles of conduit, will be nearly, if not quite, equal in purity to the Cochituate.

"That all the points bearing upon this question of purity, which are known to the Board, may be placed before you, the following remarks from the report of the City Engineer, submitted to you in March, 1873, are quoted:—

"Previously to the selection of the Sudbury as the new source for the additional supply, no analysis of its water had been published or was at command. There were, however, various reasons for believing that it is unusually free from deleterious matter either in solution or held suspended. Such was the testimony of all persons consulted, who had observed and used it. It is used, as taken from the river, in all the processes of bleaching, and is noted for its fitness for the purpose, which would indicate that it is generally free from color, and from matter in suspension. The country drained is of a character to insure purity of supply; it is for the most part very sparsely populated, contains few or no soluble rocks or earths, has quick drainage slopes that are not much cultivated, and maintains on its streams comparatively little manufacturing of an objectionable nature. After heavy rains in the summer and fall, when the drainage surfaces are covered with dead and decaying vegetable matter, the waters of rivers draining cultivated districts, or districts covered with forests and grasses, usually become more or less colored by such portions of this vegetable matter as are readily taken up in solution, or as have been washed into the streams and are held in minute forms, mechanically suspended.

"The conditions in regard to the frequency of the rains and the amount of vegetable substances in a ripe state to be acted upon, that have obtained during the past summer and fall, have been such as to develop and maintain a high color in river waters generally. Owing to the dryness of the previous year, there has been an unusual accumulation of vegetable matter ready to be taken up, either in solution or suspension, and there have been constantly recurring rains of a magnitude to produce a complete saturation of this matter, and a flow over the land surfaces to the streams. All the streams in this part of the country appear to have been affected to an unusual degree; the color began to be noticeable in the Sudbury water early in July, and continued in a marked degree till near the close of the year. It was of sufficient intensity to render the water, as taken directly from the river, unfit for washing and many other purposes.

"Samples were taken when it was at its worst state, and submitted to chemists for analysis. The following are the results obtained.

"Analysis by Dr. S. D. Hayes of Boston:—

Specimen A.

Organic matter	4.08 grains.
Mineral "	1.64 "
Total of impurities in one gallon	5.72 "

"Dr. Hayes adds: "Specimen A is a brownish yellow and almost brandy-colored; it contains $4\frac{8}{10}$ grains of purely vegetable matter, like that obtained by soaking leaves having a high tinctorial power. This water is objectionable from its color and the comparatively large proportion of vegetable matter present, but it is free from animal matter or dangerous drainage."

"Analysis of Professor Chandler, of New York:—

Specimen A.

Organic and volatile matter	2.03 grains.
Inorganic	2.93 "
Total solids in one gallon	4.96 "

“The fact is made evident in the above analyses that there may be present, at times, a large and objectionable amount of organic matter of vegetable origin, and while it is not probable that the conditions which have caused this state of the water will again exist in an equal degree, except with long intervals, it is nevertheless important to be assured that when they do exist the water can be made fit for general use.

“In 1867, commissioners were appointed to investigate the question of proper sources of supply for London and other large cities, before whom were summoned a great number of prominent chemists, and other scientific men, to give their views upon impurities of water. The commissioners in their report say:—“The organic compounds dissolved in water appear to be of very instable constitution, and to be very easily decomposed, the great agent in this decomposition being oxygen, and the process being considerably hastened by the motion of the water. Now, as such waters (river waters) always contain naturally much air dissolved in them, the decomposing agent is ready at hand to exert its influence the moment the matter is received into the water, in addition to which, motion causes a further action by exposure to the atmosphere. . . . The effect of the action of oxygen on these organic matters, when complete, is to break them up, to destroy all their peculiar organic constitution, and to rearrange their elements into permanent inorganic forms, innocuous, and free from any deleterious quality. It does not follow that all organic matter in water is prejudicial, . . . almost all our drinks, other than water, owe their distinctive qualities to the varieties of their organic contents.”

“Dr. Lyon Playfair, Professor of Chemistry in the University at Edinburgh, in his testimony before the commissioners, states:—“The effect of organic matter in the water depends very much upon the character of that organic matter. If it be a mere vegetable matter, such as comes from a peaty district, even if the water originally is of a pale sherry color, on being exposed to the air in reservoirs, or in canals leading from one reservoir to another, the vegetable matter gets acted upon by the air, and becomes insoluble, and is chiefly deposited; and what remains has no influence on health.”

“From our own experience in the use of the Sudbury water last summer and fall, when, as taken from the river, it was highly colored, and from experiments since made, there are strong reasons to believe that the effect of storage in large reservoirs, and of the exposure to the air in a long conduit, running but partially full, will be to in part or wholly decompose the organic impurities, and destroy the color. In July and August the Sudbury water was entering Lake Cochituate at the rate of from twenty to thirty millions of gallons per day, and in addition a large supply was received from the streams naturally tributary to the lake, which possessed an equal color with that of the Sudbury water; yet when these waters reached the pipes for distribution, no color was noticeable, and the slightly bitter taste, which they originally had, was lost.

“The gradual extinction of the organic matter is shown by an examination of the following table, which gives the results of analyses of three samples of water taken; the first from the Sudbury at the new dam; the second from the southern division of the lake, where the supply from the Sudbury and from Beaver Dam brook (the most important tributary to the lake) entered, and the third from the northern division, near the mouth of the conduit

By whom analyzed.	<i>Specimen A.</i>			<i>Specimen B.</i>			<i>Specimen C.</i>		
	Impurities in grains per gallon.			Impurities in grains per gallon.			Impurities in grains per gallon.		
	Mineral	Organic	Total.	Mineral	Organic	Total.	Mineral	Organic	Total.
Dr. Hayes.	1.64	4.08	5.72	1.68	2.40	4.08	1.65	1.71	3.36
Prof. Chandler.	2.98	2.03	4.96	2.45	1.40	3.85	1.87	0.81	2.68

“The remarks of Dr. Hayes upon specimen A have already been given; with reference to the other samples he says:—“Specimen B is also tinted brownish-yellow, and has the characters of Specimen A, but in a lesser degree. This water is as pure as that supplied to several cities in New England. Specimen C is almost colorless and tasteless. It is a very pure water for drinking and all household purposes. Although the proportion of vegetable matter present is larger than could be desired, it is not of an objectionable kind.”

“Sudbury-river water stored in Farm pond, after its connection with the river was shut off in the fall, and also when kept in bottles loosely corked, was found to grow lighter in color from day to day, although it still maintained its deep tinge in the river itself.

“Messrs. Merrick and Gray (analytical chemists) made an analysis of a sample taken in December last, when the river still had a decided tinge not usual to it, and found 3.23 grains of impurities of all kinds, to each U. S. gallon, of which 1.34 grains were organic matter. These amounts are somewhat less than were found by Dr. Hayes, in his analysis of Specimen C, taken from Lake Cochituate during last summer, and they would, beyond doubt, be greatly reduced by storage of the water and long exposure to the air.

“The Cochituate water was received in the city in a clear and perfectly acceptable state, and was pronounced by Dr. Hayes as very pure for drinking and all household purposes. From a sanitary point of view, the harmless nature of vegetable matter in water, unless in large quantities, is generally conceded. The testimony of chemists before the commission, already quoted, was unanimous on this point. Its great objection is the slightly bitter taste it sometimes imparts, and the brownish color it produces, a color which renders the use of the water for domestic purposes disagreeable.

“From the facts before us the conclusions may be drawn, first, that usually the water of the Sudbury river is clear and pure, and well suited for a domestic supply; second, that although subject, like all rivers, to temporary impurity of a vegetable origin, that impurity may be reduced to a harmless and inappreciable quantity by exposure to the air in storage basins and the conduit.”

“The accompanying very elaborate report of Prof. Horsford, on the purity of the water of the Mystic basin, is commended to your careful attention.

“CONDITION OF THE COCHITUATE CONDUIT.

“A very thorough examination of the whole length of the conduit has been made by skilled experts familiar with such structures, and the details of the examination, reported by Mr. D. W. Cunningham, First Assistant Engineer of ‘New Supply,’ are herewith

presented for your consideration. While the conduit will be operated with great care and closely watched, and while there is but little fear of disaster happening, yet measures have been already taken to meet any break in its weaker points by the construction of wooden flumes, ready to be applied at once at any exposed point; so that if any break should occur it can be repaired in the shortest possible time. While the condition of the conduit is and has been for the past year a constant source of anxiety to the Board, it trusts, by extra care and watchfulness, to avert any serious disaster that may imperil the uninterrupted flow of Cochituate water to the city.

"In conclusion, the Board has the pleasure of stating that the income for water is steadily increasing from year to year, the receipts of the past year showing an advance over those of the previous year of over one hundred and seven thousand dollars.

"For the Cochituate Water Board,

"JOHN A. HAVEN,

"President."

Then follows the Engineer's report, from which we make the following extracts, showing a summary of results:—

"It may be well to recapitulate here the results of our examinations on the points referred to us.

"*First.—Quantity.* The quantity of water which can be relied on from the 'Mystic pond,' by which we mean the Mystic valley, during a season of drought, and with the aid of storage reservoirs, will not, in our opinion, exceed a daily average of seventeen millions of gallons, unless the lower Mystic pond is utilized, when it might probably reach an average of eighteen millions gallons daily.

"The population now depending on this water will, it is calculated, number 269,000 souls in 1900, and will by 1898 or 1899 require all the water that the valley can furnish during a year of drought. The City of Boston cannot, therefore, rely on this basin as a source of supply, except temporarily. Until 1880 there can be drawn from this valley by means of the construction of two of the indicated storage reservoirs, a supplementary supply of 5,000,000 gallons daily, at a cost delivered, as we estimate it, of eight cents per 1,000 gallons.

"By constructing all the storage reservoirs mentioned in this report, the amount might be increased to seven or eight millions gallons daily; but we have not carried out this estimate, assuming that the supply of 5,000,000 gallons daily might perhaps meet the immediate necessities of the case with the aid of what can be got from the Cambridge Water Works, and that the other storage reservoirs could be added from time to time as they may be needed. It is to be noted that the Charlestown Works will feel the need of a storage reservoir, in all probability, before either of the two above alluded to can be constructed; this has been foreseen, and their capacities will meet as well the varying requirements of the Charlestown works.

"*Second.—Purity.* The Mystic river, before it enters the Mystic pond, receives the refuse waters of certain tanneries and glue factories, elsewhere enumerated, which, judging by their effect on the Russell's brook,—one of its lesser tributaries,—are of a very impure and objectionable character.

"The river may be further contaminated, by and by, by the sewage from the towns of Woburn and Winchester, when the construction of sewerage works at these places shall collect and concentrate it. Both of these descriptions of impurity are very objectionable contributions to a river water, but we do not think that they are likely to be for some time perceptible, after passing through the deep waters of the Mystic pond,

nor that they are sufficient to render the water drawn from that pond for Charlestown and other places, in any sense, unfit now for domestic use.

"They can all be intercepted and carried to tide-water whenever, either from their increased quantity or a greater sensitiveness on the part of the water-consumers, this course may become desirable.

"*Third.—The Cochituate Conduit.* This conduit is overtaxed now, and shows in many places signs of weakness and yielding, the most dangerous of which should, we think, be repaired and made safe next spring. The conduit cannot be thoroughly overhauled and repaired until an independent supply of water is available for the city from other sources, sufficient to admit of the Cochituate conduit being relieved from duty for some months. Until such an opportunity can be had, we are of opinion that it should not, in its present condition, be relied on to convey more than 17,000,000 gallons in any one day.

"*Fourth.—Waste of water.* To reduce this waste to its minimum and hold it in check, greater power, in our opinion, should be conferred on the Water Board, to enable them to require the correction, under penalties, of insufficient fittings within the premises of water-takers; to ascertain by frequent examination where these exist, and to prescribe the classes of service-pipes, and all kinds of fittings which are best calculated to defend the city against that needless waste which is known to exist, and which seems to be less under check here than in any other of our large cities.

"*Fifth.—Flax pond.* The addition of the water of Flax pond to your supply appears to us inadvisable, both on account of its relative cost and of the difficulties which would probably arise in its application.

"Which is respectfully submitted.

"JAMES P. KIRKWOOD,
JAMES B. FRANCIS."

In the Appendix will be found an elaborate report from Prof. Horsford, on the Mystic water, from which we take the following

"SUMMARY OF CONCLUSIONS.

"1. Of the fitness of the Mystic water for boiler use, judging from a comparison of the amount of its organic and inorganic matters with that of these ingredients in the waters of Lake Cochituate and the Croton, there seems to be no doubt. The results of inquiries conducted by the Water Board have, I understand, proved satisfactory.

"2. Of its fitness for domestic use in the laundry, it is substantially what it was at the time of its introduction, a remarkably soft water.

"3. Of its salubrity as a drinking water — it will compare well with the best waters in use for city supply. It has experienced no appreciable deterioration since its introduction.

"4. If the contributions from factories and domestic sewage continue to be no greater than they are now and have been hitherto, and the volume of water remains the same, the self-purifying power of the water will be adequate to maintain its salubrity.

"5. In case the factory drainage and domestic sewage discharging into the tributaries are steadily increased, and especially if the supply of water be from any cause diverted or diminished, a time will come when the self-purifying power of the water will be overborne. When such time comes independent drainage for the factories and

domestic sewage to a point below the entrance to the aqueduct will restore the balance.

“Respectfully submitted,

“E. N. HORSFORD.

“CAMBRIDGE, Dec. 30, 1873.”

In the Appendix will also be found a report from Mr. D. W. Cunningham, First Assistant Engineer New Supply, on the condition of the Cochituate Aqueduct.

Also, a report from Mr. W. F. Davis, on “Waste Water.”

The Mayor called the attention of the City Government in his annual message, to the importance of providing a new supply of water for the city. We give his remarks in full on this subject:—

“First, and most important, among the numerous subjects claiming your attention during the present year is that which relates to an enlargement of the water works. An abundant and unfailing supply of water is essential to the health, comfort and prosperity of the city; and, to secure this, it is evident that energetic and comprehensive measures should be taken as speedily as a proper consideration of the matter will allow. An examination of the different sources of supply has been made by able engineers, and the results which they arrived at, with the recommendations of the Water Board and the City Engineer, will be submitted to you at an early day. In order that you may comprehend the magnitude of this subject, I will state, very briefly, the present condition of our supply, and the measures necessary to enlarge it sufficiently to meet the prospective wants of the city.

“It should be understood, in the first place, that we have no rights at the present time in Sudbury river; that we cannot again make use of the temporary connection between the river and Lake Cochituate without taking the waters of the river upon the terms provided in the Act of the Legislature. It is estimated by the City Engineer that in a season of extreme drought the yield from the lake district will be reduced to twelve million gallons daily. In 1871, only 13,197,000 gallons daily entered the lake from its water-shed, and that was not a season of extreme drought.

“The consumption of the past year averaged about eighteen millions gallons daily,—three millions in excess of the previous year. If a rigid system of inspection is adopted, and the use of hand-hose restricted during this year, the consumption may be kept at eighteen millions. The natural increase thereafter will be about a million gallons per day for each year; so that in three years we must expect a consumption of twenty million gallons per day. The engineers who have recently examined the works report that, in their opinion, the Cochituate conduit should not, in its present condition, be relied on to convey more than seventeen million gallons in any one day. To maintain the supply of eighteen millions during the past year it was necessary to flow through the conduit for long periods over twenty millions, and for shorter terms over twenty-one millions, in twenty-four hours. If the maximum flow is to be limited to seventeen millions, it will be impossible to maintain an average supply for the whole year of over fifteen millions without drawing the Chestnut-Hill reservoir too low.

“It appears from examination that the Charlestown works, as they now exist, are used to their full capacity. By establishing extensive storage basins, it is estimated that a yield of thirteen or fourteen million gallons daily might be obtained from the

Mystic source. Of this, Charlestown will require over eight million gallons per day in 1874. Two years at least will be required to build the basins by which the full yield will be obtained, and in the mean time the consumption of Charlestown will have increased, so that in the year 1880 Boston could get but three or four million gallons daily from the Mystic. The estimated cost of securing a supply from this source is \$1,500,000. There are a great many practical difficulties in the way, which I will not undertake to repeat here.

“From the Cambridge works a daily supply of about three million gallons could be obtained, at comparatively small expense, if that city was annexed to Boston, and nothing was paid for the use of the water.

“From the Mystic and Cambridge works combined, an additional supply of about eight million of gallons per day can be obtained at an expenditure of about \$1,800,000. The expense of pumping will be about \$50,000 per annum, representing a capital of \$850,000. From the Sudbury river a supply of forty million gallons per day can be obtained for an expenditure not exceeding \$8,000,000, including all damages to mills and other property. The cost per annum for each million gallons a day from this source is \$200,000; from the Mystic and Cambridge combined it is \$330,000.

“It appears, then, that from the Cochituate, Mystic, and Cambridge works combined, we should have a supply for Boston of twenty-three million gallons daily, provided the Cochituate is credited with fifteen millions, which is safe for a fair summer rainfall, but which may be reduced to twelve or fourteen millions in a dry season. In five or six years the natural increase of consumption will require the maximum amount which these sources can supply. The conduit which it is proposed to build in connection with the Sudbury river will, when flowing full, have a capacity of nearly one hundred millions of gallons per day, and furnish a supply for a million and a half of people. At any time in the future the Charles river (by pumping) and the Assabet river can be turned into this conduit, should the growth of the city require. After careful consideration, the ablest hydraulic engineers in the country have pronounced in favor of procuring the permanent supply for the future from the Sudbury-river source; and I am satisfied, from the examination which I have given to the subject, that it will, in the end, be found the surest, safest, and most economical.”

This portion of the Mayor's address was referred to the Joint Standing Committee on Water of the Council, who made a brief report, Jan. 22 (see City Doc. No. 17), recommending the accompanying order.

This order was before the Council for a year, and, as finally adopted, Jan. 2, 1875, will be found farther on under that date.

Feb. 3d. The following orders of the Council were approved:—

Ordered, That the Committee on Water be requested to consider the expediency of making a permanent water connection between Farm pond and Lake Cochituate, build a conduit from Lake Cochituate to Chestnut-Hill reservoir; said conduit to be bridged over Charles river, instead of siphons in said river, and report an estimated cost of same. (See City Doc. No. 38.)

Ordered, That the Joint Standing Committee on Water consider and report upon the possibility and expense of adding to the waters of the Mystic pond a supply sufficient for the use of the city, by connecting said

pond with Shawshine, Concord, and Merrimac rivers, or either of them, by the use of the bed of the Middlesex canal, or otherwise. (See City Doc. No. 38.)

Feb. 13th. The following order was approved : —

Ordered, That the Cochituate Water Board be directed to approve for payment, from the appropriation made for a new supply of water, the expense incurred by the Committee of the City Council on Water, in procuring the information required by orders of the City Council.

Feb. 17th. The following orders approved : —

Ordered, That the Joint Standing Committee on Water ascertain, by analysis or otherwise, the purity of the water of Charles river, at the most expedient point of taking the same for the use of the city of Boston, the expense to be charged to the appropriation for additional water supply. (See City Doc. No. 38.)

Ordered, That the Joint Standing Committee on Water be requested to ascertain the number of mills, and the average amount of water required daily by each, on Charles and Sudbury rivers, respectively, as a means of obtaining an approximate estimate of the water damages which will be caused by making use of those rivers for a water supply. (See City Doc. No. 38.)

Feb. 21st. The Water Board authorized the employment of counsel by the Committee on New Supply, to assist the citizens of Framingham in their endeavor to have the charter of the Hopkinton Railroad annulled.

March 27. The following order approved : —

Ordered, That the Joint Standing Committee on Water be requested to have accurate surveys made, under the direction of the City Engineer, to ascertain the water-shed of Mystic pond ; the expense of procuring said surveys to be charged to the appropriation for additional water supply.

April 23d. The Joint Standing Committee on Water made their report on the several orders given above. This valuable report contains a report from the City Engineer on the Shawshine, Concord, and Merrimac rivers, etc. In it will be found also a report from Prof. Nichols, on the condition of certain rivers in Massachusetts. We give the report of a majority of the committee in full.

[City Document No. 38.]

“ Report on Schemes for an Additional Supply of Pure Water, 1874.

“ IN COMMON COUNCIL, April 23d, 1874.

“ The Joint Standing Committee on Water, who were requested by orders of the City Council, (1) To consider the possibility and expense of obtaining a sufficient supply of

water for the city by connecting Mystic pond with Shawshine, Concord and Merrimack rivers, or either of them, by the use of the old Middlesex canal or otherwise; (2) to consider the expediency of making a permanent water-connection between Farm Pond and Lake Cochituate, and constructing a conduit from Lake Cochituate (crossing Charles river by a bridge) to Chestnut Hill reservoir; (3) to ascertain the purity of the water of the Charles river at the point where it would be expedient to take the same for the use of the city; (4) to ascertain by accurate surveys the water shed of Mystic pond; (5) to ascertain the number of mills, and the average amount of water required daily by each, on Charles and Sudbury rivers, respectively, as a means of obtaining an approximate estimate of the water damages which will be caused by making use of those rivers for a water supply, — beg leave to submit the accompanying report from the City Engineer, furnishing the information desired under the four orders first named, and the report of Messrs. Warren and Adams of this committee, covering the information, so far as it could be procured, requested in the fifth order.

“These reports are so full and comprehensive, that it is hardly possible for the committee to add anything to them. It may be well, however, to recapitulate briefly the results which have been obtained.

“It is estimated that the yield of the Shawshine river, in a season of extreme drought, provided suitable storage basins are established, would be about 20,500,000 gallons daily. In an ordinary year a supply of 24,000,000 or 25,000,000 might be obtained. The quality of the water compares favorably with the Sudbury, Charles and Mystic.

“It will be necessary to raise the water by pumping for distribution in this city. The cost of works for an immediate daily supply of 8,000,000 gallons, planned so as to be readily enlarged from time to time, and eventually deliver the entire yield of the Shawshine, is estimated at \$2,623,775. The cost of delivering each million of gallons, on the basis of a delivery of 15,000,000 gallons daily, would be \$38.75; much higher than for the Charles and Sudbury river schemes, although a cheap class of works has been estimated upon. The plan involves the construction of a stand-pipe in place of a reservoir, the use of an open canal, and the laying of a 42-inch main over the West Boston Bridge. The stand-pipe system is an imperfect one; the use of an open canal is decidedly objectionable; and the bringing of the main supply across a wide and navigable river is attended with considerable risk.

“In this estimate, as well as in the estimates which follow, no allowance is made for mill-damages below the point of taking, or for interest during construction, or cost of negotiating loans. The mill-damages on the Shawshine, at Ballardvale, and below, would be considerable.

“The estimated cost of works built upon a different plan (such as has been proposed for the Sudbury river, see p. 18 City Engineer's Report), and capable of delivering in the city an average supply of twenty or twenty-five million gallons daily from the Shawshine, amounts to \$6,026,570. On the basis of a supply of 20,500,000 gallons daily, the cost for each million gallons delivered would be \$53.94. These works might be reduced to meet the wants of the immediate future so as to make the estimated expense \$4,480,000.

“The estimated yield of the Concord river, without storage, is 45,500,000 gallons daily. The engineer is of opinion that for the greater portion of the year the water from this source would prove unacceptable for domestic use, unless previously stored for some time. The estimated cost of works of a capacity to deliver 50,000,000 gallons daily, including a high level reservoir of a capacity of 120,000,000 gallons, is \$7,703,300. The cost of delivering each million of gallons is \$30.00. The estimated cost of works

with a stand-pipe in place of a reservoir is \$6,880,000. The mill-damages on the Concord would be very large.

"Another scheme for procuring a supply of water from this source is described by the engineer, namely, turning the Concord into the lower basin of the Shawshine, by which the water from the former would be purified to some extent. The cost of delivering 50,000,000 gallons daily, upon this plan, is estimated at \$8,341,630, exclusive of heavy mill-damages on both the Shawshine and Concord. Works of a smaller capacity ("with two engines, one compartment to the reservoir, one delivery main and the conduit brought from the Shawshine only") could be built for \$4,850,000.

"The estimated cost of works for a supply of 50,000,000 gallons daily from the Merrimack river is \$13,224,200. The scheme embraces a pumping-station, settling basins and filters at or near Lowell, and a conduit leading to the pumping-engines at Winchester. The cost of each million gallons would be \$52.24. The cost of works proportioned to immediate use is \$7,800,000.

"In regard to the quality of the water from the Merrimack, it is stated that at certain seasons of the year 'it is very turbid, and the suspended matter does not readily subside, even when the water is at rest. The amount of matter held in suspension at such times is sufficient to render the water somewhat objectionable for domestic use, and entirely unfit for many manufacturing processes.' The cost of suitable settling basins would be so large that filtration is regarded as the only practicable method of freeing the water from its mechanical impurities. The mill-damages on this river would also be very large.

"On the order in relation to establishing a permanent connection between Farm pond and Lake Cochituate, and constructing a conduit from Lake Cochituate to Chestnut-Hill reservoir, the City Engineer reports that it would be inexpedient, for reasons that are given on pp. 37-44. The estimated expense of bringing water from Sudbury river by that route is \$6,826,388.

"On the order to ascertain the purity of the water of the Charles river, at the point where it would be expedient to take it, the City Engineer submits the results of analyses made at different times during the past forty years by well-known chemists. The able report by Prof. W. R. Nichols, made last year to the State Board of Health, on the present condition of certain rivers in Massachusetts, is printed in full in the Appendix. It is evident that the water of Charles river should be held in reservoirs for some time before it is used, and possibly it would require filtration unless important changes were made in the drainage area.

"It appears from accurate surveys of the Mystic water-shed (made under the authority of fourth order), that it covers an area of 27.75 square miles, being 10½ per cent. less than the area given by the Engineer of the Mystic Water Works, and 6.6 per cent. more than that given by Messrs. Kirkwood & Francis.

"The information in relation to the damages which would accrue to the mill property on Charles and Sudbury rivers, by the use of the waters of those rivers (appended to this report), is furnished by Messrs. Warren & Adams of your committee, who, by practical experience, were peculiarly qualified to perform that duty.

"For the convenience of members, the following condensed statement is presented, showing the estimated cost of the various schemes before the City Council for an additional supply of water, with the probable time required for the completion of the same, and the cost per million gallons.

"*Sudbury river.* — Cost, \$5,150,000. (See page 58 City Doc. 29, 1873.) Time required, three full working seasons. Cost, per million gallons, \$21.17. This source will furnish a supply, in addition to the Cochituate, of 40,000,000 gallons daily in the dryest season.

"*Mystic pond*. — Cost, \$1,408,546. (See page 18 City Doc. 134, 1873.) Time required, two full working seasons. Cost, per million gallons, \$40.00. This source will furnish for use in the city south of Charles river, a temporary supply of about seven or eight million gallons daily.

"*Shawshine river*. — Scheme No. 1 (to furnish eight million gallons daily). Cost, \$2,623,775. (See page 15 City Engineer's Report, appended.) Time required, two full working seasons. Cost, per million gallons, for works of capacity to deliver 15,000,000 gallons daily, \$38,75.

"*Shawshine river*. — Scheme No. 2 (to furnish 20,500,000 gallons daily). Cost, \$6,026,570. (See page 19 of Engineer's Report, appended.) Time required, three full working seasons. Cost, per million gallons, \$53.94.

"*Concord river*. — Scheme No. 1. Cost, 7,703,300. (See page 29 City Engineer's Report, appended.) Time required, three full working seasons. Cost, per million gallons, \$30.00. This source will furnish 50,000,000 gallons daily.

"*Concord river*. — Scheme No. 2. Cost, \$8,341,630. (See page 30 City Engineer's Report, appended.) Time required, three full working seasons. Cost, per million gallons, \$32.50. 50,000,000 gallons daily.

"*Merrimack river*. — Scheme No. 1. Cost, \$13,065,000. (See page 34 City Engineer's Report, appended.) Time required, four full working seasons. Cost, per million gallons, \$53.64, by estimate of February 13, 1872. This source will furnish 50,000,000 gallons daily.

"*Merrimack river*. — No. 2. Cost, \$13,224,200. (See page 36 City Engineer's Report, appended.) Time required, four full working seasons. Cost, per million gallons, \$52.24. 50,000,000 gallons daily.

"*Charles river*. — Cost, \$3,150,000. Time required, two full working seasons. Cost per million gallons (works of capacity to deliver 50,000,000 gallons daily), without filtering, \$16.38; with filtering, \$30.00. (See pages 48, 49 and 50 City Engineer's Report, appended.) The mill damages on this river would be large. It would certainly be necessary to establish storage basins for the purification of the water, and there are no facilities for such basins on the line of the river within forty or fifty miles of this city.

"If the Sudbury-river scheme is adopted, there will be required during the next four or five years (in addition to the cost of the works) for mill-damages, interest on construction account, new supply mains for newly annexed territory, and immediate additions to the high-service work, a sum not exceeding \$3,000,000.

"The expenses connected with the taking of the Concord and Merrimack would largely exceed that amount; and for the Shawshine they would be somewhat less, — the mill-damages being smaller.

"The causes which led to the selection of Farm pond and Sudbury river as the most available sources from which to obtain an additional supply of pure water are set forth very fully and clearly in City Documents numbered 29 and 134 of the year 1873. Although the Engineer was pressed to a decision in making the selection before complete surveys had been made, subsequent investigations have fully demonstrated the wisdom of the choice. If the question was entirely open, — if no steps whatever had been taken by the government in determining a new source of supply, — the committee would, with all the information now before them, unhesitatingly adopt the Sudbury-river scheme as being, to use the words of the Mayor in his inaugural address, the surest, safest and most economical way of securing a permanent supply for the future. In the amount and quality of the water, and present and prospective freedom from pollution of the water-shed, the facilities for storage and control, the elevation (which is just sufficient to furnish the supply by gravitation and not so high as to require the

payment of unnecessary mill damages), the shortness of the conduit line to Chestnut Hill reservoir, and the comparatively low cost of delivery as a permanent supply, this scheme possesses advantages over any of the others which have been examined.

"The requisite legislation has been obtained, and the work has been actively entered upon. If any other scheme is adopted, additional legislation will be necessary, and a strong opposition will have to be encountered from other cities and towns and from private corporations; and the work which has been contracted for on the new conduit from Farm pond to Chestnut-Hill reservoir must be abandoned and lost.

"The adoption of the Cochituate scheme was violently opposed and at first rejected on the ground that the magnitude of the works was altogether beyond the future requirements of the city; and yet, in a period of less than thirty years, the wants of the city have outrun the extreme capacity of the source then selected. It must be kept constantly in view that the prosperity of our manufacturing interests, as well as the health and comfort of all our citizens, depends upon securing an abundant and unfailing supply of pure water. The prospective wants of the city are well presented in the following extract from the first report made last year:—

"It seems proper to take into consideration in this question the towns of West Roxbury, Brookline, Newton, Brighton and Hyde Park, all of which, as well as Boston, are situated upon an island formed by the harbor and the Charles and Neponset rivers and their connecting stream, Mother brook.

"The territory covered by Boston and the above towns is topographically one district, and hardly admits of subdivision when considered with reference to water supply and sewerage.

"The population of the entire district in 1870 was 287,787, and the rates of future increase applied to it will show a growth of 700,132 in fifty years, and a total population in 1920 of 987,919, or 1,000,000 of souls.

"One million of people will form a large city; but when it is considered that Boston is the metropolis of New England, with its extensive territory and increasing manufacturing population; that it is the radiating point for the whole system of New England railroads; that it possesses a fine harbor, with which no other on the New England coast can compare in facilities for commerce, and that it is likely to become the port for at least a portion of the north-west, it does not appear unreasonable to suppose that it may grow to such a size within the estimated time.

"In looking, then, for a new source of supply the wants of at least one million of people should be kept in view, and in fixing upon the capacity of the works, those parts which cannot be enlarged or readily duplicated should be proportioned for an even greater number.

"The average daily consumption per inhabitant has varied during the past few years between wide limits, having been ninety to one hundred gallons as a maximum, and somewhat less than sixty as a minimum.

"As the new area to be provided for will undoubtedly contain a less proportion of manufacturing and shipping interests than that now supplied, and as there will probably be means devised at no distant day to check the great waste that has heretofore taken place, an allowance of sixty gallons for each person should and without much doubt will be ample.

"This allowance requires a total supply of 60,000,000 gallons daily, of which fully 12,000,000 will be furnished from Lake Cochituate, and about 48,000,000 must be obtained from new sources.' [City Doc. No. 29, 1873.]

"In conclusion, the committee desire to urge upon the City Council the great importance of acting upon this matter without any more delay than is absolutely necessary to a proper understanding of it. The reports of the City Engineer and his able assist-

ants, and of Messrs. Kirkwood and Francis, furnish sufficient information to enable every member of the government to act intelligently upon the question.

“Respectfully submitted,

S. B. STEBBINS,
JOHN T. CLARK,
ALANSON BIGELOW,
FREDERICK PEASE,
EBENEZER ADAMS,
WILLIAM H. KENT,
FRANCIS HUNNEWELL,
Majority of Committee.”

The survey of the Mystic water-shed places the area at 27.75 square miles, and after deducting water surfaces, 26.22 square miles.

May 4th. The following order was passed by the Council : —

“*Ordered*, That the City Engineer be instructed to make an examination of the facilities for obtaining from Charles river a supply of water for the City of Boston, amounting to

“10 million gallons per day for 10 years, until 1884, taken from the river at Newton Upper Falls ;

“20 million gallons, for 10 years, from 1884 to 1894, and 30 million gallons, for 10 years, from 1894 to 1904, taken from the river at South Natick ;

“40 million gallons, for 10 years, from 1904 to 1914, and 50 million gallons, for 10 years, from 1914 to 1924, taken from the river at some higher point ;

“And to make an estimate of the cost, such as will enable the City Council to compare it with that of the plan for a supply from the Sudbury river.”

The report will be found in City Doc. No. 49.

May 20th. An order was approved, directing the Mayor, if he shall find the power does not already exist, to apply to the Legislature for authority for the city “to build such reservoirs and take such other means as may be necessary to secure to the Mystic Water Works the total available rainfall of the Mystic water-shed.”

On the authority of this vote, application was made to the Legislature for an act, which was secured. (See Acts of 1874.)

On June 16th the following order was approved : —

“*Ordered*, That his Honor the Mayor be requested and empowered to appoint three physicians, who shall, at an early opportunity, examine and

report upon the comparative desirability, on sanitary grounds, of the Sudbury, Mystic, Shawshine, and Charles river waters; and that the expense of such investigation be charged to the appropriation for an additional water supply."

The physicians (appointed July 20th) were Charles W. Swan, M. D., Edward S. Wood, M. D., and Henry P. Bowditch, M. D.

These gentlemen made extensive examinations of the sources above named, and their elaborate and interesting report will be found in City Document No. 102, 1874.

On November 9th, the Mayor made an advanced report from this Commission (see City Doc. No. 96, 1874). Their preferences were in the following order:—

1. Shawshine.
2. Charles.
3. Sudbury.
4. Mystic.

On June 16th, 1874, the Joint Standing Committee on Water were ordered "To ascertain and report whether the present source of our water supply from lake Cochituate and Mystic lake, combined, can be so utilized as to give an adequate water supply to the city in a season of drought; how great that supply would be; for how many years it would be adequate, and the expense of procuring it."

And on July 29th, they were requested "To examine the Charles river, and report upon its availability as a source of supply, and the expense of conveying the water to Chestnut-Hill reservoir."

They reported October 26th (see City Doc. No. 85, 1874), giving extended and valuable reports:

1st. From Mr. Joseph P. Davis, the City Engineer, on the "Charles river," etc.

2d. From Mr. A. Fteley, on "Increasing the Supply from Lake Cochituate."

3d. From Mr. D. W. Cunningham, on "Increasing the Supply from Mystic Lake."

4th. From Mr. A. Fteley, on "Waste at the Mystic Dam."

5th. From Mr. J. M. Merrick, upon "The Use of the Lower Mystic Pond for a Storage Basin."

6th. From Mr. A. Fteley, upon "Charles river."

This document contains 134 pages of interesting matter, to which any one in search of further information is referred.

On June 23d the Mayor approved the following order : —

" *Ordered*, That the Joint Standing Committee on Water consider and report upon the necessity and expediency of using Lake Cochituate as an intermediate storage-basin for the diffusion and purification of the Sudbury-river water, if said river is adopted for an additional supply."

The order was referred by the committee to the Medical Commission, and their supplementary report on the subject will be found in City Document No. 102, 1875. Their opinion was that the use of the lake for the purpose described was unnecessary, "when it is considered that storage reservoirs are contemplated in the Sudbury-river scheme."

On Oct. 22d, while these investigations were going on, the Mayor, Hon. Samuel C. Cobb, who had taken a deep interest in the subject of a new supply of water, sent an executive communication to the City Council, reviewing the water question and urging action. The unpleasant position of the Water Board in regard to the tunnel is referred to, and the government is urged either to stop the work and authorize the Board to settle with the contractor, or to give them the full authority they ask to complete the works. (See City Doc. No. 88.)

Nov. 17th. The following order was approved : —

" *Ordered*, That His Honor the Mayor be requested to petition the General Court, at its next session, for the passage of an act authorizing the City of Boston to take, hold, and convey to, into and through the city, the whole or a portion of the water of Charles river; and also to take and hold, by purchase or otherwise, from time to time, any lands or real estate necessary for building and maintaining pumping-works, and apparatus for raising, conducting, discharging, disposing of, and distributing the water, and for forming reservoirs; and His Honor to secure compensation of towns to share in the use."

Nov. 24th. The following order was approved : —

" Whereas in the discussions and allusions to the order known as an order for taking the waters of Farm pond and Sudbury river, said order now lying on the table of this Board, it has been plainly and repeatedly asserted that the scheme proposed is one of speculation, jobbing and fraud; it is therefore

" *Ordered*, That for the purpose of setting these alleged facts clearly before the City Council and the people as they should be if true, or of disproving them if they are false, that a committee be appointed, consisting of three from this branch, with such as the Board of Aldermen may join; said committee to have full powers in the matter, with authority to send for persons and papers, and do all that is necessary to make a thorough investigation of the subject, and report the result of the same to the City Council, at the earliest practicable moment."

The committee made their report Dec. 21st. No frauds could be found.

Dec. 4th. The following order was approved : —

" *Ordered*, That the Mystic Water Board be authorized to procure bonds for the conveyance to the city of such lands as may be designated by the City Engineer, for the location of a storage reservoir in the Mystic valley, and report thereon to the City Council," etc.

Dec. 17th. The full report of the Medical Commission, alluded to on p. 115, was submitted.

During the latter part of the fall and winter, an alarming drought prevailed. The lake fell beyond the point at which a supply could be maintained.

Water was purchased of the Mystic Works to the amount of \$7,652.19, and finally pumping-engines were established at the lake, to keep up the supply.

See under head of "Temporary Supply," p. 51.

1875.

The following order was approved by the Mayor, Jan. 2d, 1875 : —

"Pursuant to the provisions of section 1 of chapter 177 of the Acts of 1872, it is hereby

" *Ordered*, That the Cochituate Water Board, as the agent of the City of Boston, be and it is hereby directed to take, hold, and convey to, into and through said city, all the water of Sudbury river, so called; said water to be taken at any point or points within the town of Framingham or higher up on said river, and the water of Farm pond, so called, in said town of Framingham, and the waters which may flow into and from said river and pond, and to take any water-rights in or upon said river or pond in or above the town of Framingham, or connected therewith. Said Cochituate Water Board is also hereby directed, as the agent of this city, to take and hold, by purchase or otherwise, in connection with said sources of supply, any lands and real estate necessary for increasing or preserving the purity of the water, or for laying, building and maintaining aqueducts, water-courses, reservoirs, dams, buildings, machinery and other structures and appliances, with their accessories for conducting, elevating, purifying, storing, discharging, disposing of and distributing water; and also to take and hold any land (excepting any in the town of Framingham heretofore taken or purchased by any railroad company) on the margin of said sources of supply, not exceeding five rods in width from the high-water line of said river, storage reservoirs or pond, so far

as may be necessary, in the opinion of said Water Board, for the preservation and purity of the same, for the purpose of furnishing a supply of pure water for the City of Boston; the expense of the taking of said waters and lands aforesaid to be charged to the appropriation already existing therefor; *provided, however*, that until the further order of the City Council, no land shall be taken for the construction of a conduit between Farm pond and the Chestnut-Hill reservoir, and no money shall be expended therefor beyond the amount of the appropriation already made."

This order was passed on a reconsideration, Dec. 31, 1874.

On Jan. 5th the Water Board met to consider what steps were necessary to be taken in view of the above order. The City Engineer and City Solicitor were present in consultation. It was decided, —

First. To authorize the Committee on New Supply to see the owners of land on the line of the temporary connection between Farm pond and the lake, to make arrangements with them for the maintenance of the temporary works for a term of five years. (See p. 52.)

Second. To ask the City Council for an appropriation of \$1,000,000 for a new conduit, and \$500,000 for storage-basins.

The following is the communication referred to:—

"Request of the Cochituate Water Board for an appropriation of \$1,530,000, for a new conduit, a new siphon, and for storage-basins.

"OFFICE OF THE COCHITUATE WATER BOARD, BOSTON, Jan. 7, 1875.

*"To the City Council:—*The Cochituate Water Board, that it may provide for the city, at as early a day as practicable, an adequate and sure supply of water for domestic and manufacturing uses, requests that appropriations for the following specific purposes may be made, the amount of each being the sum which it is estimated should be spent during this year:—

The storage-basins on the Sudbury river	\$500,000
For construction of a new conduit	1,000,000
For an additional siphon pipe across Charles river, on line of the Cochituate aqueduct	30,000
Total	<u>\$1,530,000</u>

"By the action of the last City Council the Water Board is placed in a peculiar and embarrassing position. It is authorized to take the Sudbury river, turn its waters into Lake Cochituate, and to build storage-basins; but no sufficient provision has been made for meeting the cost of this work, and the Board is expressly prohibited from taking any land for a new conduit and from incurring any expense thereon which would exceed the present depleted appropriation. The Water Board have heretofore, in various reports to the City Council, called attention to the dangerous condition of the existing conduit and its extreme liability to accident (involving a short supply of water) from the strain put upon it by running it under a head.

“Messrs. Kirkwood and Francis, the eminent engineers employed by the Board to examine it, say: ‘The recent examination has shown very clearly that parts of the conduit are now unsafe, and may fail at any time;’ and after speaking of the overtaxing of the conduit and the signs of weakness and yielding, as shown by the opening of cracks in the brick-work, the most dangerous of which they recommend repairing and making safe in the spring of 1875, they say:—

“‘The conduit cannot be thoroughly overhauled and repaired until an independent supply of water is available for the city from other sources, sufficient to admit of the Cochituate conduit being relieved from duty for some months. Until such an opportunity can be had, we are of opinion that it should not, in its present condition, be relied on to convey more than 17,000,000 gallons in any one day.’

“The conduit has been repaired in as thorough a manner as the limited time the water could be kept shut off would permit, but nothing has been done to strengthen it at the weak points; yet the Water Board is obliged, in order to keep up the supply of water, to run much more than 17,000,000 gallons per day through it.

“In asking for an appropriation of \$30,000 for an additional siphon pipe across Charles river, it is anticipated that it may be necessary, before a new conduit can be built, to force a delivery of twenty to twenty-three millions of gallons per day through the old conduit, by running it under a three or four foot head at the upper end. Such a use, or rather abuse of it, with any precautions that can be taken against accident, will be extremely dangerous.

“It will be seen, therefore, that the Water Board, acting under the authority at present granted to it by the City Council, cannot provide the city with an ample supply of water, except at great risk. Storage-basins on the Sudbury will be of no use without a new conduit to convey the water to the city.

“The lake from its own water-shed and the ordinary flow of the river, unaided by storage-basins, can be kept at a height that will provide all the water the conduit can safely carry; though it should be understood that the channel from Farm pond to Lake Cochituate, and the dam for diverting the water from the river, were constructed for temporary purposes only, and are not such works upon which so vital an interest as the supply of water to the city should be allowed long to depend.

“To secure an ample supply of water and to remove the difficulties under which the Board labors; to relieve it from the necessity of refusing to allow the use of water for many purposes that would increase the prosperity and give a new impulse to various manufacturing interests, the Board believes the construction of a new conduit is an imperative necessity.

“In view of the careful and accurate surveys and investigations which have been made by the City Engineer and his assistants; the endorsement of the plans by Mr. Chesbrough, under whose direction the Cochituate Works were built; the proximity of the line at South Natick to the Charles river, from which an increased supply can be obtained, if necessary, in the future; the increased rate of inclination above that of the Cochituate conduit and its favorable location on an entirely independent line; together with the great advantage of having all the plans in readiness, and thus being able to at once put the work under contract, the Water Board does not hesitate to reaffirm its opinion that the interests of the city will be best subserved by the construction of the proposed conduit from Farm pond to Chesnut-Hill reservoir.

“Impressed with the importance of immediately commencing the work, and feeling that it would be remiss in its duty if it delayed an expression of its views, the Water Board has thus early in the year presented its request for appropriations for the purposes mentioned.

"Two years have passed away since this question of new water supply was presented to the City Council, and while its action during the closing hours of the past year has averted the threatened calamity of a water-famine, the responsibility of keeping up the supply, by increasing the strain upon a conduit already overtaxed, must rest upon it until the requisite appropriations and authority to build a new conduit are granted.

"THOS. GOGIN, *President.*"

Jan. 7th. The Committee on New Supply of the Water Board were authorized "to notify the mill-owners below Framingham that it is the purpose of this Board to take the waters of Sudbury at an early day." The same committee were authorized "to employ some person to ascertain the actual amount of damages occasioned by taking the waters of the Sudbury river."

On Jan. 21st the Mayor and the members of the Water Board signed the formal taking of the Sudbury river, of which the following is a copy: —

"TAKING OF SUDBURY RIVER.

"Whereas, by an Act of the Legislature of the Commonwealth of Massachusetts, passed the 8th day of April, 1872, entitled 'An Act to authorize the City of Boston to obtain an additional supply of pure water,' it is provided among other things, that

"The City of Boston is hereby authorized, by and through the agency of the Cochituate Water Board, to take, hold and convey to, into and through said city, all the water of Sudbury river, so called, said water to be taken at any point or points within the town of Framingham, or higher up on said river, and the water of Farm pond, so-called, in said town of Framingham, and the waters which may flow into and from said river and pond, and to take any water-rights in or upon said river or pond, in or above the town of Framingham, or connected therewith."

"And by section 5th of said act, it is likewise provided, that in regard to such taking, injury, interference and flowage, and the ascertainment and payment of all such damages, the said City of Boston, and all persons claiming damages, shall have all the rights, immunities and remedies, and be subject to all the duties, liabilities, and regulations, which are provided in the one hundred and sixty-seventh chapter of the Acts of the year eighteen hundred and forty-six, and the three hundred and sixteenth chapter of the Acts of the year eighteen hundred and fifty.

"And, whereas, in said 167th chapter of the Acts of the year 1846, it is provided that the City of Boston shall, within 60 days from the time they shall take any lands or ponds, or streams of water, for the purposes of this Act, file in the office of the registry of deeds where they are situate, a description of the lands, ponds or streams of water so taken, as certain as is required in a common conveyance of lands, and a statement of the purpose for which taken; which said description and statement shall be signed by the said Mayor;

"And whereas, pursuant to the provisions of Section 1st of chapter 177, of the aforesaid Acts of 1872, it was ordered by the City Council of the City of Boston, 'that the Cochituate Water Board, as the agent of the City of Boston, be and it is hereby

directed to take, hold, convey to, into and through said city, all the water of Sudbury river, so called, said water to be taken at any point, or points, within the town of Framingham, or higher up on said river, and the water of Farm pond, so called, in said town of Framingham, and the waters which may flow into and from said river and pond, and to take any water-rights in or upon said river or pond, in or above the town of Framingham, or connected therewith;

"Said Cochituate Water Board is also hereby directed, as the agent of this city, to take and hold, by purchase or otherwise, in connection with said sources of supply, any lands and real estate, necessary for increasing or preserving the purity of the water, or for laying, building, and maintaining aqueducts, water-courses, reservoirs, dams, buildings, machinery and other structures and appliances, with their accessories, for conducting, elevating, purifying, storing, discharging, disposing of, and distributing waters; and also to take and hold any land (excepting any in the town of Framingham heretofore taken or purchased by any railroad company), on the margins of said sources of supply, not exceeding five rods in width, from the high-water line of said river, storage-reservoir or pond, as far as may be necessary, in the opinion of said Water Board, for the preservation and purity of the same, for the purpose of furnishing a supply of pure water for the City of Boston; the expense of the taking of said waters and lands aforesaid to be charged to the appropriation already existing therefor.

"Provided, however, that, until the further order of the City Council, no land shall be taken for the construction of a conduit between Farm pond and the Chestnut-Hill reservoir, and no money shall be expended therefor beyond the amount of the appropriation already made;—

"Now, therefore, know all men by these presents, the City of Boston, by the Cochituate Water Board aforesaid, Thomas Gogin, Leonard R. Cutter, Charles R. McLean, L. Miles Standish, William G. Thacher, Edward A. White, and Edward P. Wilbur, duly appointed and constituted, and by virtue of the power and authority in said Act given, and in part execution of the same, have taken, and by these presents do take, for the sole use and benefit of the said City of Boston, all the water of Sudbury river, so called, at and above the dam built by the City of Boston, in 1872, five hundred feet, more or less, below the crossing of the said Sudbury river by the Boston, Clinton and Fitchburg Railroad, in the town of Framingham, in the County of Middlesex, and near the brook which is the outlet from Farm pond into said river, and all the water in the said dam to the source or sources of said river; also all the water in Farm pond, so called, in said town of Framingham, and all the water in the brook connecting Farm pond with Sudbury river; also all the water in all the streams, brooks and rivulets, or water-courses of any kind, whether natural or artificial, that may flow into or from said Farm pond, and into or from said Sudbury river, at any point or points above said dam; subject to the restriction set forth in Section 4 of Chapter 177 of the Laws of 1872, with reference to said water;

"To have and to hold the said waters to the said City of Boston, and its successors and assigns, to its and their sole use and behoof, agreeably to the provisions of the said Act of the year eighteen hundred and seventy-two.

"In witness whereof, I, Samuel C. Cobb, Mayor of the said City of Boston, and the said Cochituate Water Board, have prepared the foregoing description of the waters taken for the purposes aforesaid, in conformity to the requirements of the Acts aforesaid, to be filed in the office of the Registry of Deeds, for the said County of Middlesex, and have hereto set our hands, and affixed the common seal of the City of Boston,

being hereto duly authorized, the twenty-first day of January, in the year eighteen hundred and seventy-five.

“ CITY OF BOSTON

BY

“ SAMUEL C. COBB,

“ *Mayor.*

“ Signed and sealed
in presence of
JAMES L. HILLARD.

“ THOMAS GOGIN, *President.*
EDWARD A. WHITE,
CHARLES R. M'LEAN,
WILLIAM G. THACHER,
L. R. CUTTER,
EDWARD P. WILBUR,
L. MILES STANDISH.”

The same day that the above order was signed, the following vote was passed by the Board : —

“ *Voted*, That the City Engineer be directed to cause the water to be turned from Sudbury river through Farm pond to Lake Cochituate, in accordance with the purpose and action of this Board in seizing said river.”

The following order was approved by the Mayor, Feb. 26th : —

“ *Ordered*, That the City Treasurer be and he hereby is authorized to borrow, under the direction of the Committee on Finance, the sum of \$1,500,000, to be added to the appropriation for ‘Additional Supply of Water.’ And the Cochituate Water Board, in addition to the powers heretofore granted said Board by the City Council, is hereby authorized to take, by purchase or otherwise, lands and real estate necessary for building an aqueduct between Farm pond and Chestnut Hill reservoir, and to construct such aqueduct and to do all other acts authorized to be done by an act of the Legislature entitled ‘An act to authorize the City of Boston to obtain an additional supply of pure water,’ given in chapter 177 of the Acts of 1872, necessary for storing and purifying and bringing to Chestnut Hill reservoir the waters of Sudbury river; *provided*, however [that the number of storage reservoirs said Water Board is authorized to construct shall not exceed three, which shall be those known as numbers 1, 2 and 3, and], that the doing of all work, and the furnishing of all materials for any portion of the work, the cost of which is estimated to exceed \$10,000, with the exception of such portions of the aqueduct as pass under railroad tracks (which may be built by days’ labor, or by contract, according as the said Cochituate Water Board, with the advice of the City Engineer, may decide), shall be let out by the said Cochituate Water

Board to the lowest responsible bidder. Notice that the said Cochituate Water Board will receive proposals for such work shall in all cases be published at least five times (the last publication to be not less than one week before the opening of the bids), in such newspapers — not less than three — of the City of Boston (and when the said Board may think it expedient, of other cities), as the said Board may direct; such notice shall state the kind and estimated amount of work to be done, or the materials to be furnished, and the time when to be done or furnished, and the place where plans and specifications may be seen, the place where and the period within which the bids will be received. Each bid must be signed by the bidder, and be accompanied with a bond for such sum not less than \$500, as the said Board may determine, conditioned for the faithful execution of the contract, with satisfactory sureties for its performance within the time required by the advertisement, in case the bid be accepted; or in case the person or persons bidding shall prefer, a sum of money in such amount, not less than \$500, as the said Board may determine, may be deposited with the said Board, in lieu of the bond above mentioned, and said bond or deposit shall be forfeited to the City of Boston in case the bidder fails to execute the contract within the time specified, if it is awarded to him.

"The bid and bond, duly signed and sealed, must be enclosed in a sealed envelope, and the bidder shall state his own place of residence, and all other particulars that the said Board may require, in the terms of the advertisement. The bids shall be opened by the president of said Board [or the presiding member], and publicly read at the office of said Board, in the presence of the majority of its members, and any bidder who may wish to be present, at such day and hour as may be specified in the advertisement. A bond, with sureties, or security satisfactory to the said Board, shall in all cases be required for the faithful performance of the contract. The said Board shall reserve the right to reject any or all bids, for cause.

"*Ordered*, That the Cochituate Water Board be and they are hereby authorized to construct a siphon pipe across Charles river, on the line of the Cochituate aqueduct; and that the cost of the same be charged to the appropriation for Water Works."

Feb. 26th, the Water Board voted, "That the City Engineer be authorized and instructed to prepare at once plans and descriptions for the taking of the lands necessary for the building of the Sudbury-river conduit, also to prepare plans and specifications for the work of the various sections of the conduit, that the same may be advertised and placed under contract at as early a day as practicable; and, with the

advice and approval of the Committee on Additional Supply, to take such steps and do such acts as he may find advisable and are within the powers granted to the Water Board by the ordinances of the City Council, relating to an additional supply of pure water, that may be properly delegated to a committee by the Board, for beginning and finishing the entire work proposed for bringing to Chestnut-Hill reservoir the waters of Sudbury river. For this end he is hereby authorized, with the approval of the President of this Board, to hire such assistants as he may find advisable, and fix the salaries to be paid them, to rent offices, and to purchase instruments, furniture and supplies, and to incur such other expenses connected with the engineering work as he may find necessary."

Feb. 26th. A petition was sent to the county commissioners of Middlesex county for the right to change the highway between Framingham Centre and the Worcester turnpike, in connection with the building of a storage reservoir.

The same day the following vote was passed by the Board : —

"*Voted*, That the Water Board proceed to seize the land now covered by water, in consequence of building a dam, now in use, on Sudbury river, and such other lands as become necessary, as described by the City Engineer in a document prepared by him (and which is now on file), dated March 16, 1875."

The City Solicitor having given an opinion, March 10th, that the Water Board had no authority to contract for work on the new conduit beyond the amount appropriated by the Council, the Board sent a communication to the Council on March 22d, stating that under their order "the Board has no authority to make contracts in amount exceeding the actual appropriations granted by the City Council. It is essential to the prompt and economical performance of the work that the Board should not be restricted in their authority to contract for doing those things which the City Council has already authorized them to do, and they would therefore respectfully request that adequate permission be made to enable them to proceed with the work in the manner best calculated to serve the interests of the city."

April 7th. The Water Board adopted a line for the new conduit, as shown on a plan, April 7th, signed by the President. The following is the vote : —

"*Voted*, That the line surveyed by the City Engineer for a conduit from Farm pond to Chestnut-Hill reservoir, shown on a plan signed by the President, April 7th, and filed in this office, be hereby adopted by the Water Board as the line on which the said conduit shall be built."

The Committee on New Supply were authorized to settle damages not exceeding \$3,000 in amount on the new conduit.

In April, the Mayor, with the approbation of the City Solicitor, appointed C. C. Esty, Esq., of Framingham, legal adviser of the Water Board in negotiations pertaining to the acquisition of lands, and other matters connected with the new works.

April 12th. The Mayor approved the order appropriating \$4,500,000 for the new works.

The following is the order :—

"Ordered, That the Cochituate Water Board be and it is hereby authorized to contract for building the whole of the aqueduct between Sudbury river and Chestnut-Hill reservoir, and the works connected therewith, and, also, for constructing the three reservoirs designated in the order of the City Council, approved the 26th of February, 1875, and the works connected therewith necessary for storing and purifying the waters of Sudbury river, the appropriations of money heretofore made for an 'additional supply of water' to be applied in making payments on account of said contracts, and of other expenses incurred by said Board under the authority of the orders of the City Council, approved the 11th of April, 1873, the 2d of January, 1875, and the 26th of February, 1875; provided, however, that the contracts herein authorized shall be made in the manner specified in the said order of the City Council, approved the 26th of February, 1875; and provided, also, that the estimated expense of the work to be performed under all of said contracts, including the contracts entered into under the authority of the said order of the City Council, approved the 26th of February, 1875, shall not exceed the sum of \$4,500,000."

The Water Board, having at length obtained authority to build a new conduit, proceeded to advertise at once for proposals to execute the work. Invitations for bids were issued in the leading Boston and New York papers.

The remainder of the year was principally spent in receiving bids, awarding the contracts, and examining the bonds. This involved a great amount of labor on the part of the Board and its engineers. Many of the contractors were not residents of Massachusetts. Steps were taken only after mature deliberation, and with legal advice. The first proposals, viz., those for Sections 2 and 3, were opened on May 20th, at 12, M., in the office of the Board. The general dulness of the times attracted a great many bidders, and during the days that the bids were opened, the rooms of the Board, on the first floor of City Hall, were thronged with eager faces, awaiting the reading of the several items as they were called off by

the clerk. The bids were made on a basis of quantities of materials in each section, estimated by the engineer, necessitating the reduction to a fixed sum, for purposes of comparison, and before an award could be made. This work was done by the engineering force, under Mr. J. P. Davis' directions, whose able and conscientious superintendence of the details of all matters connected with the new supply have been of so great assistance to the Board.

The contracts for all the sections of the conduit were awarded before the close of the year.

There were nineteen sections in all. (See Description.) Section 1 was reserved to build by days' labor. The contract for Section 10, the last one made, was not declared till Dec. 27th, but the larger part of the work was under way during the summer, and portions of the conduit were wholly built and back-filled before the close of the working season.

CONANT FARM PURCHASED.

May 13th, 1875, the Conant farm, of some sixty acres, in Needham, was purchased for \$7,000, the conduit running through its length. The farm-house is used as offices for the engineering force.

MASSACHUSETTS BONDS.

It was a question with the Board whether to exact Massachusetts bonds of the contractors or not, and on May 21st they passed the following vote:—

"*Voted*, Not to exact Massachusetts bonds, provided the contractors give bonds satisfactory to the Board."

The matter was afterwards taken up in the City Council, and an order was introduced May 31st, requiring the Board to exact Massachusetts bonds; but the Committee on Water, to whom the order was referred, reported, June 14th, that it was inexpedient, and no action was taken.

June 1st. The West farm bought for \$5,000.

June 18th. It was "voted to sign the declaration of the taking of lands in Newton, owned, or supposed to be owned, by David Austin, Mrs. Alexander Donaldson, and Wm. B. Fisher, through which the tunnel is being constructed in part.

June 22d. Plans of lands taken by the city in Framingham, Sherborn, Natick, Needham, and city of Newton, adopted.

June 26th. Papers signed for seizure of lands on line of conduit.

The same day the following vote was passed : —

"Whereas the papers for taking the lands for the purpose of building the Sudbury-river conduit from Station 6 to Chestnut-Hill reservoir have been executed, and, whereas, the contracts for Sections 2, 3, 4, 7, 9, 11, 12, 14, 17 and 18 of the conduit have been signed and executed, therefore be it voted, that the Clerk shall notify the City Engineer to set the stakes, and give the contractors for the above-mentioned sections the necessary information, that they may at once proceed with the work."

July 27th. The engineers were authorized to strengthen the dam on Sudbury river, and prepare a section of the river for gauging.

Sept. 16th. The Board voted to settle with Mr. A. A. Lawrence for \$12,000 for tunnel damages.

Sept. 23d. Dr. Parker, of Framingham, settled with for \$1,500, for a lot containing about ten acres, and the rights of flowage over three acres.

The same day Messrs. Lobdell & Phelps presented a written agreement to complete the Beacon-street tunnel by Dec. 31st, 1875.

Sept. 30th. Contract for a highway in Framingham awarded to Mr. John Brown, of Mohawk, N. Y. ; bonds fixed at \$13,000.

This road had to be built on account of the proposed flooding of the old road by basin No. I.

On Oct. 8th the Board voted to ask the City Council for authority to build Section 1 of the Sudbury-river conduit either by days' labor or by contract, and on Oct. 30th the Mayor approved the following order : —

"*Ordered*, That, for the reasons set forth in the communication from the Cochituate Water Board to the City Council, dated the 11th day of October, A.D. 1875, the order passed by the City Council, and approved the 26th day of February, A.D. 1875, authorizing the said Water Board to build a conduit from Farm pond to Chestnut-Hill reservoir, and to do certain other things mentioned therein, be and the same is hereby so far modified as to authorize the said Water Board to build Section 1 of the Sudbury-river conduit, and the foundations of the dams for basins numbered I., II. and III., by days' labor, or by contracts let without advertisement, as the said Board may deem best for the interests of the city."

Oct. 21st. The City Engineer was authorized to advertise for Sections 10 and 15, bidders to furnish bonds for \$15,000, and the sureties on the bonds to be residents of the State of Massachusetts.

Nov. 3d. The City Engineer was authorized to employ some one to drive the piles for the crossing of the conduit under the Boston and Albany Railroad at South Framingham.

Nov. 11th. "*Voted*, That the Engineer, under the direction of the Committee on New Supply, be authorized to build Section 1 of the Sud-

bury-river conduit, and do the work on the foundations of the dams for basins Nos. I., II. and III., by days' labor; and for this purpose he is further authorized, under the direction of said committee, to employ such superintendents, foremen and laborers, and to hire such horses, carts, etc., and to purchase such materials, tools, etc., as he may find expedient."

Nov. 23d. The Committee on New Supply, after several interviews with Gen. B. F. Butler, made a report to the Board, when it was

"*Voted*, That the Committee on Additional Supply be authorized to settle with General B. F. Butler, acting for himself and the Wamesit Power Company of Lowell, for a sum not exceeding fifty-five thousand dollars; provided, a full release be given to the City of Boston by said company, satisfactory to the City Solicitor, from every and all damages, compensation and claim of damages of whatever name and nature, arising out of or because of the taking by said city, of the water of Sudbury river, and provided also that an absolute conveyance be given to said city of a certain quantity of water, equal to $2\frac{66}{88}$ (but never exceeding 66 cubic feet per second) of the water flowing in the canal of said company, when the water is below the top of the permanent stone dam of said company; said water to be drawn only for eleven and one-quarter hours per day, for six days in each week.

"The said sum to include, also, a retainer for the personal legal services of the said General Butler, for any and all suits which may be brought against said city by any and all parties, on account of the taking of the water of said Sudbury river by said city. And that said committee be further authorized to offer twenty thousand dollars additional to the above sum of fifty-five thousand dollars, to said General Butler, acting for said Wamesit Power Company, in case the said quantity of water flowing in the canal can be offset, in whole or in part, for the rightful and legal claims of all parties having rights to take water from the said canal. Provided the said parties maintain their rights in Court against said city (or that their rights are acknowledged by the proper representatives of said city), by reason of the taking of the water of said Sudbury river; it being understood that in case the city cannot avail itself of the said quantity of water as an offset as above provided for, the said city shall quitclaim to the said Wamesit Power Company its full right and interest in and to said quantity of water."

On November 29th the committee reported to the Board "that a settlement had been made with General Butler." On Dec. 2d the papers were signed.

Nov. 29th. The Board voted to place two siphon pipes across Rosemary brook.

Table of Sudbury River Conduit.

SECTION.	BIDS OPENED.	DATE OF FIXING BONDS.	BONDSMEN ACCEPTED.	CONTRACT SIGNED.	BREAKING OF GROUND.
1.....	.... [Reserved	.....	.....	.....	Nov. 11, 1875
2.....	May 20, 1875..	May 21, 1875..	June 8, 1875..	June 22, 1875..	Sept. 23, "
3.....	" 20, " ..	" 21, " ..	" 8, " ..	" 22, " ..	July 10, "
4.....	" 21, " ..	" 24, " ..	" 18, " ..	" 22, " ..	" 11, "
5.....	" 21, " ..	" 24, " ..	" 29, " ..	July 20, " ..	" 28, "
6.....	" 26, " ..	June 11, " ..	" 8, " ..	" 2, " ||	" 1, "
7.....	" 26, " ..	" 28, " ..	" 8, " ..	June 22, " ..	" 2, "
8.....	" 27, " ..	" 11, " ..	" 8, " ..	July 2, " ||	" 3, "
9.....	" 27, " ..	" 2, " ..	" 18, " ..	June 22, " ..	" 1, "
10*.....	Nov. 18, " ..	Dec. 27, " ..	Dec. 30, " ..	Dec. 30, " ..	Jan. 18, 1876
11.....	May 28, " ..	June 1, " ..	June 18, " ..	June 22, " ..	July 2, 1875
12.....	" 28, " ..	" 1, " ..	" 18, " ..	" 22, " ..	" 8, "
13.....	June 2, " ..	Sept. 7, " ..	Sept. 9, " ..	Sept. 23, " ..	Sept. 27, "
14.....	" 1, " ..	June 2, " ..	June 18, " ..	June 22, " ..	July 6, "
15.....	Nov. 18, " ..	Nov. 18, " ..	Nov. 29, " ..	Dec. 2, " ..	Dec. 9, "
16.....	June 2, " ..	June 22, " ..	July 7, " ..	July 10, " ..	July 17, "
17.....	" 3, " ..	" 8, " ..	June 15, " ..	June 22, " ..	" 1, "
18.....	" 1, " ..	" 4, " ..	" 15, " ..	" 22, " ..	" 27, "
19.....	" 3, " ..	" 22, " ..	July 7, " ..	July 10, " ..	" 27, "
20†.....	Aug. 7, 1873..	Aug. 30, 1873..	Aug. 30, 1873..	Aug. 30, 1873..	Sept. 3, 1873

* Section 10 was grant, the City Solicitor was requested by the Board, Dec. 27th, to sue the bond.

† Beacon-street tunnel.

‡ This Section was origin for this Section.

§ Mr. Lobdell died early

|| With certain provisio

NOTE. — Massachusetts

Statemary River Act of 1872.

NUMBER.	DATE.	PAGE.	REMARKS.
1	January 217	45	No Plan.
2	March 167	47	No Plan.
3	June 187	95	Plans with original records.
4	" 267	103	Land Plans Numbers 1 and 3, filed.
5	" 24468 ...	221	Land Plan Number 2, filed.
6	September 367	192	Plan with the original records.
7	December 87	206	Plan filed.
8	April 14478 ...	237	Plan with original records.
9	" 127	252	Plan with original records.

Dec. 2d. Papers signed for seizure of land for Basins Nos. I. and III.

Dec. 9th. Beacon-street tunnel accepted by the Board, and the balance due the contractors paid.

1876.

Jan. 13th. Proposals authorized for pipes for the siphon and reservoir connections.

Linus M. Child, Esq., engaged as junior counsel for the Sudbury river cases.

Feb. 3d. Contract awarded to Thomas Leighton, of Rochester, for an iron bridge across Stony brook, in Framingham, for \$1,150.

March 2d. The Board sent plans for Dam No. 1 to the Commissioners of Middlesex County for their approval, which was received March 9th.

March 9th. The Board sent a communication to the same authorities, for permission to raise the highway at Cutler's Mills.

The same day the "engineer was authorized to employ such assistance as is necessary to gauge the Concord river at Lowell; and also four persons, at not exceeding \$50 per year, to keep rain gauges in the Sudbury District."

March 23d. The engineer was authorized by the Board to organize a party for the new storage-basins.

Takings signed for lands for Basin No. II. in the town of Ashland.

April 12th. The Board voted "that the engineer be authorized to lay the pipes for the siphons in Needham by days' labor, and to employ the Superintendent of the Eastern Division to do the work."

April 27th. Some little trouble having been experienced from a strike on the line of the conduit, the selectmen of Needham petitioned the Board for police protection. After a consultation with the City Solicitor the Board decided that they had no authority to appropriate money for police protection in towns through which the conduit was being constructed; and a communication was sent to the selectmen to this effect.

May 18th. Plans for dam and basin No. III. sent to the County Commissioners for their approval.

The following is a list of the Committees on New Supply:—

May 6th, 1872.* Messrs. Charles H. Allen, John A. Haven and Alexander Wadsworth.

* On April 15th, 1872, the Board voted to create a Committee on New Supply, and the President, with Messrs. Bradlee and Haven, were appointed.

May 6th, 1873. Messrs. John A. Haven, Edward A. White and Charles R. M'Lean.

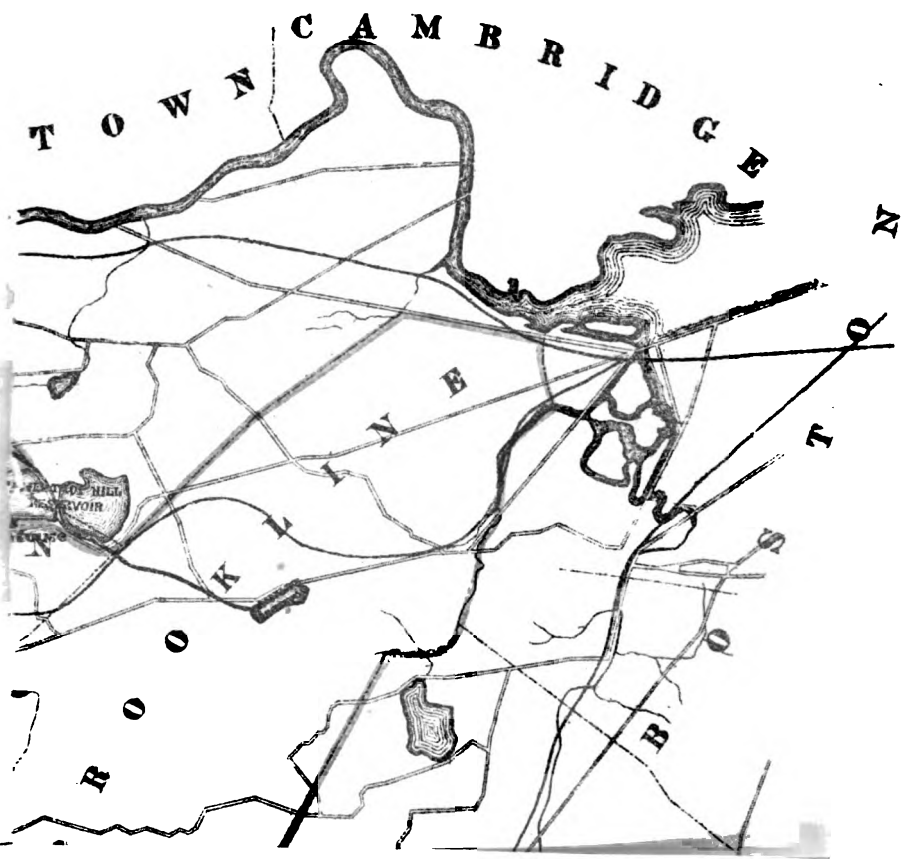
Dec. 19th, 1874. Messrs. Thomas Gogin,* Charles R. M'Lean and L. Miles Standish.

May 6th, 1875. Messrs. Thomas Gogin,† Leonard R. Cutter and L. Miles Standish.

May 1st, 1876. Messrs. L. Miles Standish, Leonard R. Cutter and Charles E. Powers.

* Mr. Gogin had been serving for some time previous, owing to the illness of Mr. Haven.

† Resigned May 31st, 1875, and Mr. L. Miles Standish elected President and *ex-officio* Chairman of the Committee. On July 12th, 1875, Mr. Charles E. Powers was elected.



DESCRIPTION OF THE WORKS FOR A "NEW SUPPLY OF WATER."

As these works are now in course of construction, an accurate and detailed description would be impossible. Such a description will be made by those in immediate charge of their execution, when the plans have been carried out. The following outline will, however, give a general idea of the scheme, which may not be uninteresting at this time. A large portion of the facts are taken from Mr. J. P. Davis' report on "An Additional Supply of Water," City Document No. 29, 1873.

The Sudbury river rises in the town of Westboro', and after flowing through the towns of Southboro', Hopkinton and Framingham, is joined at Concord by the Assabet. The union of these two rivers forms the Concord, which flows in a northerly direction to Lowell and there discharges into the Merrimac. In its passage through the town of Framingham the Sudbury river is joined by Stony brook, an important feeder. The junction occurs a short distance from the village of Framingham Centre. It is at this point that the waters of the river have been taken. The drainage area of the water-shed above the dam, which is to be erected here, is 77.8 square miles. As a rule, the slopes are quite steep and the surfaces are not covered with a rich vegetation, nor much broken up for cultivation; hence a large percentage of the rainfall may be expected to reach the brooks and streams. In the above estimate of area Stony brook is included. Its drainage slopes cover about twenty-six square miles. They are more rocky and precipitous than those of the main branch, and in consequence the water is fully up to the quality of the Sudbury, if not superior.

Many analyses have been made by several chemists, from which it is evident that the Sudbury-river water, although sometimes slightly colored by temporary impurity of a vegetable origin, is generally clear, pure, and well suited for a domestic supply. The temporary color will be almost entirely removed by exposure to the air in the storage reservoirs.

AVAILABLE SUPPLY.

With the facilities for storage, twelve inches of available rainfall has been taken as a basis for the estimate. This is a less quantity than has usually been taken, but, from careful investigations by Mr. J. P. Davis, it appears that it would not be safe to rely upon a larger quantity for a *minimum* yearly supply. This estimate gives as a result a supply at all

times of 40,000,000 gallons per day. Under the average conditions of rainfall and absorption, the supply will be 50,000,000 gallons per day.

SCHEME OF WORKS.

The scheme for the Sudbury Works consists in the building of seven storage reservoirs on the river, three of which it is intended to build at once, with a short conduit for delivering the water into Farm pond. This pond has been alluded to under the head of "Temporary Supply," where its relation to the river will be found described. From Farm pond a conduit fifteen and one-half miles in length will convey the water to Chestnut Hill reservoir, where provision will be made to connect the Sudbury with the existing works.

The total estimate for this work was \$4,788,318, and the prospects now are that it will be completed for less than this sum.

STORAGE-BASINS.

The seven storage-basins, with Whitehall pond (a reservoir built by the city in connection with the Cochituate Works, to provide compensation water for the mills) and Farm pond, give a total storage of about 648,000,000 cubic feet, or 4,847,552,989 gallons.

Basins Nos. I., II. and III., with Farm pond, have a capacity of about 273,000,000 cubic feet, or 2,042,371,130 gallons, and are adequate for a daily supply of about 20,000,000 gallons.

Dam No. 1, which will be built a short distance below the junction of Stony brook with Sudbury river will flow basin No. I. in the form of a crescent, the two arms extending up the two branches and nearly meeting at their extremities.

Dam No. 2 on the Sudbury branch will flow a long narrow basin, No. II., extending to the crossing of the Boston and Albany Railroad at Ashland.

Dam No. 3 on Stony brook will flow basin No. III., which crosses the Boston, Clinton and Fitchburg Railroad, and will extend a short distance beyond the boundary line between Southboro' and Framingham.

Basin No. I. will have an area of about 126 acres; No. II., 154 acres; No. III., 285 acres. Farm pond has an area of 190 acres.

"On account of the value of the land flowed and other private interests destroyed, the character and magnitude of the dams required, and the cost of raising and protecting town roads and railroads, the cost of

basins Nos. I., II. and III. will be comparatively large. Basin No. II. flows out two mill privileges of considerable value. No. III. includes within its boundary an extensive swamp, now covered with a heavy growth of wood, and they all flow large tracts of meadow land, supporting a rich vegetation, which it is desirable to have removed by grubbing and excavation, as it will otherwise have to be gotten rid of by gradual decomposition. The cost of this class of work will, however, be so great as to limit its application to small areas where the most benefit will be produced, such as that in the upper part of basin No. II. The vegetable matter upon other tracts must await the slower processes of chemical change, in undergoing which it will be apt at first (especially in the summer months) to deteriorate the water. This action will in part or wholly cease, after a while, and the basins will slowly assume the character of natural ponds and lakes."

In the design for dam No. 1, provisions have been made for joining it with Farm pond by a covered conduit. Dams Nos. 2 and 3 are to be connected directly with the gate chamber of dam No. 1 by means of pipes laid on the bottom of basin No. I. Water may be let into these pipes from the upper basin, through gates located to draw from any desired level, and conveyed directly to the conduit without intermixture with other water.

FARM POND.

Very little work on Farm pond will put it in good order. It is proposed to raise the level from 146.75 to 149.25, or two and a half feet, and to use the pond to this extent as a storage-basin. It will also serve a valuable purpose in the purification of the water.

CONDUIT.

After leaving Farm pond, the general direction of the conduit for about five miles is south-easterly, thence north-easterly about nine miles, and thence easterly to Chestnut Hill reservoir. Its total length is about 15.61 miles.

The first mile of its course is through the town of Framingham, then for two and three-quarter miles it passes through Sherborn, then three miles through Natick, then five and one-third miles through Needham, and, finally, about three and three-quarter miles through the city of Newton to the gate-house at the reservoir, which will be very near the boundary line between Newton and Boston.

The whole conduit, with the exception of Section 1, is building by contract. For convenience of letting, the line has been divided into twenty sections, beginning with Section 1 at Farm pond, and ending with Section 20 at Chestnut Hill reservoir.

The gate-house at Farm pond will be built in the water about two hundred and fifty feet from the shore-line. It will be erected on a pile foundation to be enclosed by a coffer-dam.

Arrangements will be made at this gate-house to connect with a conduit from the storage-basins on the Sudbury river whenever it shall be built, or to draw from Farm pond.

At the shore of the pond the line crosses the Boston and Albany Railway.

This part of the work, some six hundred feet in length, including the portion in the pond, is building by the city by days' labor.

For convenience of description, reference will be made to the stations on the conduit line. These are one hundred feet in length. The following table will show where each section begins and ends, and its length in feet. —

Section 1.	Station 0	to Station 6	600	feet.
2.	6	51 + 50	4,550	"
3.	51 + 50	114 + 50	6,300	"
4.	114 + 50	155 + 70	4,120	"
5.	155 + 70	190	3,430	"
6.	190	229	3,900	"
7.	229	284 + 25	5,525	"
8.	284 + 25	315 + 55	3,130	"
9.	315 + 55	381	6,545	"
10.	381	388	700	"
11.	388	432	4,400	"
12.	432	509	7,700	"
13.	509	551 + 50	5,250	"
14.	561 + 50	623	6,150	"
15.	623	639	1,600	"
16.	639	684	4,500	"
17.	684	730	4,600	"
18.	730	737	700	"
19.	737	773 + 22	3,622	"
20.	773 + 22	824 + 65	5,143	"

Total length, { 82,465 feet,
or 15.61 miles.

The crossing of the Boston & Albany Railroad is from Station 360 to 525. At Station 11 + 25 the line crosses the Milford branch of the Boston & Albany Railroad; and at Station 66 + 50, on Section 3, there is a crossing of the Framingham & Mansfield Railroad. These are all the railroads the line encounters in its course.

At Station 34 + 67, on Section 2, the line crosses Beaver Dam brook, the chief feeder of Lake Cochituate. The level of the water in the brook and conduit being about the same, necessitates the carrying of the brook under the conduit by a large siphon culvert. One of the chief peculiarities of the line, in these first sections, is that it crosses the streams at so low a level that they have to be carried under the conduit by inverted siphons. This, on the other hand, gives advantageous crossings of the highways, as their grades are not raised.

The excavation through Sections 2, 3 and 4 is principally sand and quicksand, which requires more or less sheeting, bracing and pumping. On Section 2 the line passes through two soft peat-holes or pockets. The first, at about Station 17, is two hundred feet in length.

Here the peat extends to but a few feet below the grade line. The other is at Station 25, and is about the same length as the first; but the peat is several feet deeper. The peat at these points is entirely removed and its place filled with gravel to a sufficient width to allow the slopes of the embankment to rest wholly on solid bottom.

At Station 112, at the lower end of Section 3, the line crosses Course brook, another feeder of Lake Cochituate. Arrangements will be made here to empty the conduit into the brook, so that the waste water from the Sudbury conduit will pass into the lake. Throughout the whole length of the conduit manholes are provided, about fifteen hundred feet apart; a certain number of these are of such a section as to allow of their use for gauging chambers to measure the flow of the conduit by means of the current meter or floats.

The first four sections pass through an open farming country; but at Section 5 the line encounters the "Sherborn swamp," the surface of which is about two feet above the grade-line or bottom of the conduit. The swamp is covered with a thick growth of woods. The line was located by soundings. The excavation was made in sections. No sheeting was found necessary. The peat was removed from five to fifteen feet in depth, and its place filled with gravel, well rolled in layers, and allowed to remain over winter to solidify before building the masonry upon it.

The first rock cut of any importance occurs in Section 4. It is about

six hundred feet long, and ten feet deep in the deepest portion, containing about twenty-five hundred cubic yards.

On Section 6 the first tunnel is encountered in one of the spurs or ridges making out to Charles river, and separating one valley from another. This tunnel is seventeen hundred and sixty feet long, and will be more fully described under the head of "Tunnels."

Section 7 is built entirely through woods and swamp. On this section occurs the largest peat excavation on the line. It is about five hundred and fifty feet long. The peat extends in the deepest portion fifteen feet below grade, and the top of the peat is level with the grade line of the conduit. No sheeting was found necessary. The same course was pursued in this case in preparing the foundations as on Section 5. There are three small rock cuts on this section. The general quality of the material, other than the swamp, is gravel and hard-pan.

On Section 7, at Bacon's brook, Station 271 + 40.2, is the second waste weir; a masonry chamber built around the conduit, and provided with gates so that the conduit may be emptied for repairs or examination. Bacon's brook empties into Charles river.

Section 8 includes the Badger Hill tunnel, fifteen hundred and seventy-five feet in length. (See "Tunnels.")

Section 9 is chiefly noticeable for passing close to the banks of Charles river and through the grounds of H. H. Hunnewell, Esq. The excavation is all gravel. The level of the water in the conduit will be some forty feet higher than the water in Charles river. When the consumption of the city increases beyond the supply to be derived from the present sources, water can be pumped into the conduit from the river; the objectionable impurities being found mostly below this point. The area of the contributing water-shed is one hundred fifty square miles, or considerably more than that of the Sudbury and Cochituate lake areas combined.

Section 10 is the Waban-brook bridge, or the "Waban arches," the bridge being formed of nine semi-circular arches, of forty-four feet eight inches span each. The drainage area of Waban brook, above this point, is about ten square miles. The valley is about forty feet deep, and nearly two thousand feet long. The line, as located, passes through a small knoll after leaving the bridge, and the conduit will be carried over the remaining portion of the valley on an embankment. The Waban bridge will be a handsome structure. It is to be built of Maine granite with a brick parapet and iron railing. On account of a quicksand foundation, all but one of the piers have been founded on piles. The total length of the bridge, between the slopes of the end parapets, is five hundred and

thirty-six feet. The embankment, which is in Section 11, is about thirty feet high and some twelve hundred feet in length.

Section 11 is built through a rather poor open farming country. The excavation is largely hard-pan and rock. "Denning's cut," in this section, is about thirty-five feet deep in the deepest portion. About six hundred feet of this cut was through rock some fifteen feet deep, at one point.

The excavation on Section 12 is gravel, with boulders and some ledge. The most noticeable features of this section are "Fuller's waste weir," and a long cut extending into Section 13, and about a mile in length. The wet portion of this cut, some one-half mile in length, is on Section 12; it is mostly quicksand, while the dry portion, on Section 13, is gravel.

On Section 13 is the Almshouse embankment, some thirty feet in height at the deepest portion of the valley, and about seven hundred feet in length. This embankment covers the location of a former town-way, in consequence of which the Water Board were required, by the Selectmen of Needham, to build a new road forty feet wide, around the side hill, involving some heavy work.

Not far east of the Almshouse embankment comes the Rosemary-brook siphon. The valley of Rosemary brook, which is here crossed in its narrowest point, is about eighteen hundred feet wide. It is to be crossed by three lines of forty-eight-inch pipes, two of which only will be laid at present. The channel of the brook will be covered with an arch-culvert ten feet in diameter, and blow-offs will be placed in the pipes at this point. The siphon-chambers will be furnished with tell-tale pipes to detect leakage. The chambers will be substantial masonry structures. The drainage area of Rosemary brook, above the crossing, is about sixteen hundred and ten acres. Its water surface is fifty-five feet below the grade of the conduit. The distance from Farm pond is ten and three-quarters miles.

Section 13 is located in an open farming country.

On Section 14 there is a cut of about half a mile in length, and the second largest embankment on the line. It is some fifty feet in height at the deepest point.

Section 14 is built, for the most part, through light woods, with no heavy work.

Section 15 comprises principally the Charles-river bridge, distant 11.8 miles from Farm pond, the most important structure on the line of the new conduit. Its length is four hundred and seventy-five feet between the chambers at the ends of the bridge. At the westerly end is an arch of thirty-seven feet span, partly cut off by the slope of the hill, then comes

a long span-arch which crosses the river. This arch is one hundred and thirty feet span. It is segmental, and the radius is sixty-nine feet. The thrust of this arch is taken directly by the rock foundation on both sides. There are four semi-circular arches, of thirty-seven feet span, on the easterly side of the river, and a flat arch, with a span of twenty-eight feet over Ellis street, a town-road. The bridge is to be built in a most substantial manner of granite and brick-work. The piers, arches and abutments up to the level of the conduit will be of granite, and above this there will be a handsome face-brick parapet, formed by pilasters into panels, and capped with a heavy granite coping, the whole surmounted by an ornamental iron railing.

At Section 16, which passes through the village of Newton Upper Falls, the conduit line strikes a more thickly settled country. This section is partly embankment and partly excavation. The material is gravel, and the country is undulating.

There is one rock cut on this section, near Boylston street, some seventeen feet in depth at the deepest point, and several hundred feet in length.

Section 17, in the village of Newton Highlands, is all gravel excavation.

Section 18, in Newton Centre, is the gravel tunnel. (See "Tunnels.")

Section 19 is all gravel and sand excavation, with the exception of a small piece of embankment on the Wardwell estate. Waste Weir No. 4 is located at this point, viz., Station 738 + 15. It empties into Hammond's brook.

Section 20 is the Beacon-street tunnel.

The section adopted for the conduit is shown on the opposite plate.

It is equivalent to a circular section of eight and one-half feet diameter, and, in ordinary conditions of cleanliness, — that is, with some sand deposits on the bottom and with considerable vegetable growth at its upper end, such as is found soon to take root in the Cochituate conduit, — will deliver at the rate of about seventy millions gallons in twenty-four hours, when flowing at the assumed water line.

Such a capacity will enable the supply to be kept up when the old conduit is thrown out of use for any reason, or when the water is required to be delivered directly to the distribution without the intervention of the reservoir, which will at times be drawn down for cleaning or repairs. It will also admit of the future extension of the works, by turning the Assabet river into the Sudbury, or by pumping from the Charles.

The section is of stronger form than is usually given. It is designed to have sufficient stability to resist the lateral thrust of the contained water and the arch.

Adjusted Water Bill
ADDITIONAL SUPPLY

SECTIONS OF THE

SUDBURY RIVER CONDUIT

June 1878



In Dry Excavation



In Wet Excavation

[illegible]

the fact that the majority of the population is still illiterate, and that the majority of the population is still illiterate, and that the majority of the population is still illiterate.

1. The first step is to identify the problem. This involves understanding the current situation and the goals that need to be achieved.

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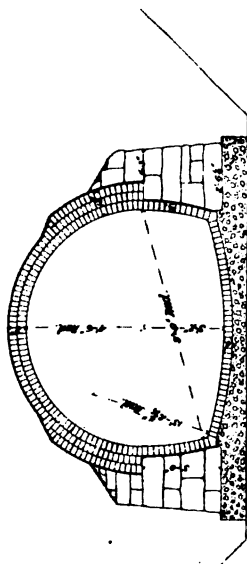
1. *Journal of the American Medical Association*, 1990; 263: 1001-1005.
 2. *Journal of the American Medical Association*, 1990; 263: 1006-1010.
 3. *Journal of the American Medical Association*, 1990; 263: 1011-1015.
 4. *Journal of the American Medical Association*, 1990; 263: 1016-1020.

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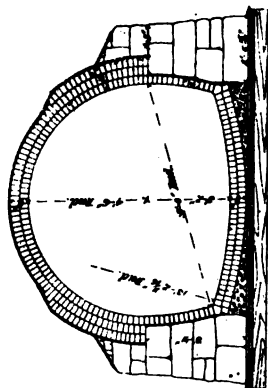
Eastern Water Works
ADDITIONAL SUPPLY

**SECTIONS OF THE
SUDBURY RIVER CONDUIT**

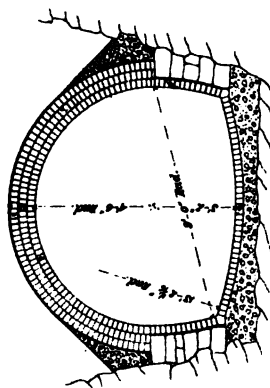
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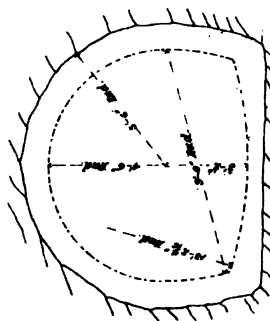
In Dry Excavation.



In Wet Excavation.



In Rock Excavation.



In Rock Tunnel.



The arch and interior lining are of brick, and the side walls of rubble-stone masonry.

WASTE WEIRS.

No. 1.	Course	brook.	Station	112.
" 2.	Bacon's	"	"	271 + 40.
" 3.	Fuller's	"	"	459.
" 4.	Hammond's	"	"	738 + 15.

BLOW-OFFS.

Rosemary brook. Station 553.

TOWN LINES.

Framingham	and	Sherborne,	45 + 72.
Sherborne	"	Natick,	191 + 68.
Natick	"	Needham,	350.
Needham	"	Newton,	633 + 50.
Newton	"	Boston,	82.824.

DRAINAGE AREAS OF STREAMS CROSSED.

Beaver-Dam brook,	3,195 acres.
Course	" 1,343 "
Sawen's	" 768 "
Bacon's	" 977 "
Waban	" 12 square miles.
Rosemary	" 1,610 acres.
Charles river,	200 square miles.

TUNNELS.

There are four tunnels on the line of the new conduit, including the small gravel tunnel on Section 18.

The first, on Section 6, known as the Rockland-street tunnel, begins at Station 201 + 80, and ends at 219 + 40. These are the points where the actual headings began, and do not include the open-cut approaches. Its length is consequently seventeen hundred and sixty feet. More water was encountered in this than in either of the other tunnels. The roof is very bad, and has to be heavily timbered for a great part of its length. The west end will have to be lined with brick-work. So far the rock in

the east end is sound. The tunnel was begun in a kind of red granite, of a rather loose quality.

The approaches on both sides were started in August, 1875. The westerly heading was started in October, 1875, and the easterly heading two months later. The headings met July 3d, 1876. The rock is removed entirely by hand labor, giant powder and glycerine being used for explosives.

The second tunnel in order eastward from Farm pond is through Badger hill.

Two lines were run to avoid this tunnel. One would have involved crossing Charles river twice, and the other, skirting around the point of the spur, would have carried the line through the village of South Natick, with large land-damages.

The west heading of the tunnel is at Station 294. The east heading is at Station 309 + 75, making the tunnel fifteen hundred and seventy-five feet in length. The material of the first three hundred feet of the easterly end was hard-pan. The rock at the westerly end is a kind of red and gray granite, very solid, and requiring no brick-work.

The headings were both begun in September, 1875.

The third tunnel, near Pleasant street in Newton Centre, is the gravel tunnel, five hundred and twenty-five feet in length. There are but forty-five feet of gravel over the tunnel in the deepest portion. It was built to avoid land-damages, which would have been heavy had the excavation been made as an open cut, the line passing through valuable property. The tunnel was excavated with difficulty, requiring the closest attention and skill in fixing the timbers to avoid caving. The bents, of ten-inch timber, were placed some four feet apart on centres, and closely timbered with long wedges. One hundred feet of solid rock excavation was encountered in the centre. The rest of the material was a loose sand and gravel, with a few boulders. This tunnel was begun in September, 1875.

The fourth and longest tunnel is the Beacon-street tunnel, in Newton. It is 4,635 feet long between headings.

The westerly heading is at Station 776 + 65.26.

The easterly " " " 823 + 00.26.

The construction of this tunnel was prosecuted from four faces, two of which ran from a shaft some fifty feet in depth, sunk in a favorable valley between two summits, and near the centre of the tunnel.

Work was begun on the two approaches and the shaft in September, 1873, the City Council having appropriated the money for this work some two years in advance of the rest of the conduit. See "History of the New Supply." The first work done on the eastern heading was in

December, 1873, and on the western heading in February, 1874. Work on the two headings at the bottom of the shaft was begun in January, 1874. The shaft was at Station 793 + 65. Most of the work was done with compressed air. An improved drill, known as the Winchester drill, introduced in November, 1874, added very much to the rapidity with which the work was executed.

The rock was a solid conglomerate, with more or less slate.

The only brick-work required in this tunnel, on account of poor rock, is some eighty feet in length. The meeting of the headings at the easterly end occurred at Station 805 + 91, July 16, 1875, and at the westerly end the headings met at Station 785 + 12, on July 30, 1875. The whole tunnel was completed and accepted in December following. A layer of concrete was spread over the bottom.

Mr. George S. Rice was the engineer in charge, and Messrs. Lobdell & Phelps were the contractors.*

* By the death of Mr. Lobdell, early in the work, the completion of the contract devolved upon Mr. Henry W. Phelps.

PART THIRD.

HISTORY AND DESCRIPTION OF THE HIGH-
SERVICE WORKS.

HISTORY AND DESCRIPTION OF CHESTNUT-
HILL RESERVOIR.

DESCRIPTION OF THE CITY MAINS.

1868.

HISTORY OF THE HIGH-SERVICE WORKS.

The annexation of Roxbury to Boston, January 6th, 1868, rendered a high-service system necessary. The area of that portion of the territory annexed which was too high to be supplied from the existing works, was about seven hundred and sixty acres.

Surveys made by the City Engineer, in anticipation of annexation, had determined the elevation of all door-sills above grade eighty. The subject of how best to supply this district engaged the attention of the Water Board during the greater part of the year 1868. Visits were made by the City Engineer, and the committee having the matter in charge, to other cities. After an examination, a report was made to the City Council, November 30th, in which the President states that the Board had unanimously chosen the "Stand-pipe" system. On December 19th the direction of the necessary works was placed in the hands of the President and the Committee on Eastern Division.

The system consisted briefly of two pumps, with a rated capacity of two millions four hundred thousand gallons each in twenty-four hours, and a stand-pipe.

By a vote of the City Council, approved March 19th, 1869, a portion of the Station-house lot on Washington street (old Ward 15) was sold to the Board. This lot, in conjunction with another small piece, was adopted as a site for the engine-house.

Some discussion ensued as to the location of the stand-pipe. The spot recommended by the Board was the "Old Fort Lot," so called, of revolutionary fame, and on April 20th, 1869, an order was approved, setting apart this piece of land, which was owned by the city, for the purpose designated. A number of citizens opposed this disposition of the lot, on the ground that it should be sacredly preserved as a relic. A petition was referred to the Joint Standing Committee on Water, who reported, July 12th, "that if these earthworks were at the present time in anything like their original state, it would be desirable to preserve them as an interesting memorial of such an important event; but time and the action of individuals have made such inroads upon them that their value

as a memorial is lost." The site was also described as being necessary for the Water Works.

Active progress was made on the high-service system during the season of 1869, and the works were so far completed as to allow of starting the pumps on February 25th, 1870. They were put in operation in the presence of the Mayor, the Water Board, and the Committee on Water. Although most of the pipes had been laid before it was intended to subject them to the pressure of the high service, there was but one leak after the increased head was let on.

On June 4th, 1870, the high service was let on to Beacon Hill to test the pipes and to play the fountain on the Common. One or two leaks appeared and were stopped, after which, on June 6th, the high-service supply to this part of the city began.

It was not long before the people of South Boston, living on the high portions of that district, began to petition for the high service. On July 16th an order was approved, directing the Board to "inform the Council if it is practicable to furnish water to the high service of South Boston."

July 20th the matter was referred to the City Engineer, Mr. N. Henry Crafts, who reported September 7th, recommending an eight-inch pipe for the high service of South Boston. He says, "I have drawn the division line between the high and the low service substantially the same as in the case of the Beacon-Hill high service; that is, to include all houses in the high service whose door-sills are at a level of fifty-five or more above 'tide-marsh level.' The Independence-square district has only twenty-two houses where door-sills are above grade fifty-five, and the highest one is at grade sixty-nine. This district is all built over. The Telegraph Hill district has three hundred and seven houses where door-sills are above grade fifty-five, and the highest one is at grade one hundred and eight."

The ultimate requirements of these districts is estimated at about two hundred thousand gallons per day, and the number of houses at six hundred and fifty-seven. (See City Doc. No. 15, 1871.)

At this time the Board had under consideration the matter of laying a twenty-inch main from Upham's Corner, in Dorchester, to the reservoir in South Boston, and on September 21st they gave authority to the Superintendent to lay the pipe.* As this main could be used as a high-service pipe, they reported to the City Council, September 26th, 1870, that, "while admitting the practicability of the plan for supplying South Boston with the high service, they deem it inexpedient at the present time." (City Doc. No. 86, 1870.)

In the mean while, January, 1870, Dorchester had been annexed. This

* Completed and connected with the reservoir in May, 1871.

new district brought some twenty-five hundred acres more of high-service territory into the city. In June the citizens petitioned for water, and on the 19th of July, 1870, an appropriation was made. Surveys begun as early as 1869, and which were in progress, were hastened, and the Water Board were obliged to consider both South Boston and Dorchester in their plans for the extension of the high service. The year 1871 was spent in discussing a number of different plans and reports of the City Engineer. On March 21st, 1872, the Board authorized its "Committee on Eastern Division to carry out the high-service system in South Boston in consultation with the City Engineer," and on July 15th, 1872, the necessary connections with the high service in Roxbury having been completed by way of Bowdoin street, Dorchester, the high service was let on to South Boston.

In August, 1872, a connection was made between the Beacon-Hill high service and the Mystic works in Charlestown, so that in case of accident the water from those works could be turned on.

September 5th the Mystic Water Board informed the Cochituate Board, that in case of an emergency every facility would be afforded for furnishing water in their power.

The increased consumption from the extension of the high service to these new districts taxed the machinery to such an extent that the Board appointed a committee on December 5th, 1872, "to report what action is required to increase the present capacity of the pumping-works for the high service. The result of this action was an elaborate report from the City Engineer, Mr. Joseph P. Davis, made March 4th, 1873, reviewing the capacity of the works, the prospective needs of the high service, and recommending a comprehensive plan for the future. (See City Doc. No. 38, 1873.)

We make the following extracts from this report: —

"OFFICE OF THE CITY ENGINEER, CITY HALL.

"BOSTON, March 4, 1873.

"CHAS. H. ALLEN, Esq., *President Cochituate Water Board*: —

"SIR, — The following report relating to the best method of increasing the effective capacity of the high-service system of water supply is made by request of Mr. Haven, Chairman of Committee on Eastern Division.

"The districts included within the limits marked out on the map for the high-service distributing system constitute more than one third of the present area of the city.

"They are: Beacon Hill in Boston Proper, Telegraph Hill in South Boston, Parker's Hill, Fort Hill, Tommy's Rock and the Seaver Hill Territory in Roxbury, and the range of high lands which forms the greater portion of Dorchester; making in all an area of about 3,500 acres.

"A part of this area is not now supplied with water, in fact has scarcely any population, and a large portion of that which is supplied is not thickly populated; but both

parts contain some of the most desirable land for residences within the city limits, and evidently are destined to be rapidly occupied.

"Future annexations will greatly increase the high-service area, both absolutely and relatively, and if all the territory extending to Mother brook, between the Charles and Neponset rivers, shall form the future city, or one metropolitan district, then the area to be supplied from your high-service system will be very much larger than that to be furnished with water by the low service.

"It is therefore evident that the high-service works will in a few years form one of the most important divisions of the entire system of water supply, and it is particularly desirable that their general character and outline shall be determined upon at as early a day as the necessary data for this purpose can be obtained, that whatever extensions are made in the existing system may, if possible, be so made that they will form parts of, or be available for, the system of the future.

"Although the data are not now at command from which even a general outline of this system can be determined, nevertheless, there are certain features which it must or should have, that can be pointed out, and which have a bearing on the question that is the more immediate subject of this report.

"The water must be raised by machinery to an elevation that will give the requisite head upon the distributing pipes, and it is of great importance that at the point where this machinery is located there shall be a large store of water, that no interruption may occur to the supply in case the aqueduct or pipe which furnishes the water to the pumps is temporarily thrown out of use for examination, or repairs, or by accident to it.

"This condition requires the eventual abandonment of the location of the engines which now supply the high service, for a new one either at the Chestnut Hill or the Brookline reservoir, or at some new reservoir that may be built, specially for the purpose, at a more favorable point.

"There are other reasons than that of a want of a store of water, why the present location on Elmwood street, of the high-service machinery, is not the proper one for the machinery of a system of works that is to supply an extensive territory and a large population. There is want of room at this point; the engine buildings would be exposed to the attacks of fires originating on neighboring premises; the location is on the outskirts of the territory to be supplied, or is not sufficiently central for an economical system of distribution; it would require the water to be brought to it in pipes, at great cost, and a considerable loss of head; and it is so low that a pressure of over thirty pounds per square inch is created on the suction side of the pump-piston, which produces a harsh action of the machinery, and to some extent impairs its efficiency.

"The new works should be of a kind that have reservoirs as centres for the distributing-pipe systems.

"The area to be supplied consists of various districts, more or less isolated, for each of which there should be, as a matter of economy, a distinct system of distribution, and, to secure to them an uninterrupted supply under a nearly constant head, and that the supply mains leading to the districts may be of the minimum size and cost, reservoirs should be established at convenient points."

Here follows a description of the pumps, which, as it is given elsewhere, we omit. Mr. Davis also considers the question of increasing the pumping capacity, and sums up:—

"The chief objection to this plan is, that a large expenditure will be necessary for

machinery, buildings, mains, etc., which probably will be thrown out of use at the end of a few years.

“A reservoir can be built on Parker’s Hill, at an elevation that will give sufficient head on the high-service pipes, or with a water-surface of about two hundred feet above tide-marsh level.

“If this reservoir be connected with the stand-tower on Fort Hill, it will be put in good communication with the high-service distributing system, and will *instantly* respond to any demand for a sudden increase of supply.

“The ratio between the average and maximum quantities of water pumped in an hour, during each month, has varied in the past year from $\frac{1}{100}$ to $\frac{1}{250}$, as shown in the following table:—

Table showing the average and maximum quantities of water pumped in an hour, and the ratios between them, for each month of 1872.

MONTH.	Average.	Maximum.	Ratio.
	Gallons.	Gallons.	
January	81,474	80,370	As 1 to 2.55
February	81,118	62,640	As 1 to 1.69
March	82,681	78,265	As 1 to 2.39
April	81,068	51,700	As 1 to 1.66
May	82,391	62,640	As 1 to 1.63
June	85,240	50,525	As 1 to 1.43
July	86,615	58,515	As 1 to 1.60
August	85,190	68,620	As 1 to 1.95
September	84,515	62,510	As 1 to 1.81
October	84,216	66,035	As 1 to 1.93
November	85,696	75,905	As 1 to 2.13
December	40,008	76,375	As 1 to 1.91
Averages	84,184	64,508	As 1 to 1.89

“From the above it will be seen, that an engine which has to vary its speed as the consumption of water varies is required to be about double the capacity of one doing the same work under a uniform speed; that is to say, to furnish a given supply, an engine pumping into a stand-pipe should have twice the capacity of one pumping into a reservoir.

“Hence it follows that the building of a reservoir, besides insuring an ample supply of water for the extinguishment of fires, would, by virtually doubling the pumping capacity, be equivalent to the addition of a new engine having twice the power of each of the existing ones.

“If it be built to serve a temporary purpose only, its connection with the stand-tower may be made with a line of twenty-inch pipes; but as its proposed location is the proper one for one of the auxiliary reservoirs of the future high-service system, its pipe connections should be proportioned for future use, and this use should be kept in

"THIRD ESTIMATE.

Reservoir on Parker's Hill; capacity about 6,000,000 gallons	\$73,500
Line of twenty-four-inch pipe to stand-tower	39,500
Land damages	100,000
	<hr/>
	\$213,000
Add ten per cent.	21,300
	<hr/>
Total	\$234,300

Respectfully submitted,

JOSEPH P. DAVIS,
City Engineer."

This report was sent by the Board to the Council with a recommendation in favor of a new reservoir, and that application be made to the Legislature for the requisite authority.

The President of the Board, Mr. Charles H. Allen, states in this report that the precautionary measures recommended by the City Engineer had been adopted.

On June 23d, 1873, the Water Board voted to connect the South Boston high service with the 30-inch main on Tremont street by a 12-inch pipe through Dover street. The 30-inch main referred to was at this time doing duty as a high-service main. This pipe was laid during the season of 1873. It involved a new siphon pipe at the Dover-street draw, which will be described further on. This siphon was successfully lowered into place Dec. 24th, 1873. During the season of 1873 a 16-inch pipe was laid from opposite Mason street across the Common to Mt. Vernon street, and early in 1874 it was continued westerly to Berkeley street. During the season of 1874 this same main was carried to Heath street. Between Heath and Berkeley streets it was made 20 inches in diameter. The work was completed in November, 1874, and the water from the high service let on. By the laying of this high-service main, the old 30-inch main was restored to its former use in reinforcing the low service.

On May 10th, 1875, the following order was approved:—

"*Ordered*, That the Cochituate Water Board be requested to consider and report to the City Council what changes are necessary in the system of high-service works to meet the present and prospective wants of those depending upon that service for a water supply; also to consider and report upon the subject of laying a new main from Chestnut-Hill reservoir."

The above order was referred by the Water Board to the City Engineer, and on Nov. 18th he made a report to the Board, which, on Dec. 2d, the Board voted to transmit to the Council. (See City Doc. No. 117, 1875.)

“Report of Cochituate Water Board upon Change in High-service Water Supply, and the laying of a new Low-service Main.”

“CITY OF BOSTON.

“OFFICE OF THE COCHITUATE WATER BOARD,
BOSTON, Dec. 2, 1875.

“To the City Council of the City of Boston:—

“In submitting the accompanying report of the City Engineer upon a new high-service system of water-supply, and ‘upon the subject of laying a new main from Chestnut-Hill reservoir,’ the Cochituate Water Board desires to express the following opinions:—

“*First.* That, owing to the recent annexation of West Roxbury and Brighton with their large areas of high lands, the constant extension of the high service in the older divisions of the city, and the increase of consumption that will result from increase of population in the districts now supplied, very largely increased facilities for furnishing the high-service supply will soon be imperatively demanded.

“*Second.* That, for reasons stated in the Engineer’s report, the present site of the pumping machinery should be abandoned when any large increase in the works is made.

“*Third.* That a plan of new works should be adopted at an early day, and that, if the City Council concur in this opinion of the Board, the Legislature should be petitioned at its next session for the needful authority to build it.

“*Fourth.* That the plan proposed and recommended by the Engineer—that of pumping machinery located at Chestnut-Hill reservoir, with three distributing reservoirs and large connecting mains—is the one that should be adopted.

“*Fifth.* That provisions, as proposed, for furnishing a temporary high-service supply to the Brighton division should be made early next season.

“*Sixth.* That there is no immediate necessity for laying a new low-service main from Chestnut-Hill reservoir.

“For the Cochituate Water Board,
“L. MILES STANDISH,
“President.”

“HIGH SERVICE.

“Before suggesting any changes in the high-service system of water supply, a brief description of it, as it now exists, will be in place.”

We omit the description, as it will be found elsewhere.

“The capacity of the existing works is then about 1,800,000 gallons per day.

“If new suction and delivery mains are laid, so that both engines may be operated at the same time, the capacity of the works will be about 2½ million gallons. This is assuming that no accident will happen to either engine which will require more than five or six days to repair, the supply during the time of such repair being kept up by the delivery from the other engine, and the water in store in the reservoir.

“The cost of the new mains would be about \$6,500.

“The works were built to supply the high lands of Roxbury alone, and they were designed with a capacity amply sufficient to provide, for years to come, for the wants

* The portion of the Report relating to a new low-service main will be found on p. 64.

of that rapidly-growing section; but they were not intended and are entirely inadequate to supply the demands for water that will arise, in the near future, from the extension of the distribution to Beacon Hill and the high grounds of South Boston, and the rapid increase of the population living upon the large areas of elevated lands in Dorchester, West Roxbury and Brighton.

"The area which the works were designed to supply is about 760 acres; the area of high-service territory now within the limits of the city is about 10,720 acres, and the population of this territory, as approximately estimated from the census of this year, is 36,600, divided as follows:—

Beacon Hill	High Service,	.	.	.	.	.	.	6,000
South Boston	"	"	.	.	.	.	.	3,000
Roxbury	"	"	.	.	.	.	.	12,000
Dorchester	"	"	.	.	.	.	.	5,800
West Roxbury	"	"	.	.	.	.	.	7,400
Brighton	"	"	.	.	.	.	.	2,400

"The average daily rate of consumption from the Cochituate works last year was about 70 gallons per head, and the rate during the months of maximum consumption (July, August and September) was nearly 80. If we allow for the high-service supply a rate of 70 gallons per head for the months of maximum consumption, it will be seen that, were the street pipes extended through the whole high-service territory, the required supply would be a little over 2,500,000 gallons per day;—a quantity which is in excess of the present capacity of the works.

"As has been before stated, if new force and supply mains be laid, the capacity of the works will be increased to about 2,750,000 gallons per day; but, with the rate of increase of population which obtains in the high-service districts, the maximum consumption will reach this quantity in two or three years.

"It is evident, therefore, that in a few years the present works must be either enlarged or replaced by a new system of greater capacity and better adapted to fulfil the new conditions that will then exist; and when it is considered that the high-service territory includes more than half the area of Boston lying south of the Charles river, and contains a yet larger proportion of the vacant land desirable for residences, it is further evident that this new system must be designed on a scale to provide for the wants of a very large population.

"The cost of extending the distributing mains and pipes, and the cost of new reservoirs, if equal storage capacity be provided in each case, will be practically the same whether new works are built or the old ones are enlarged.

"The chief difference of cost will be in the pumping machinery, its buildings, and supply and delivery mains. The pumping machinery and its location are, therefore, the points to be considered in deciding what changes it is best to make.

"There are a number of forcible reasons why no considerable enlargement of the pumping capacity should be made at the present location of the engines on Elmwood street.

"There is want of room at this point. The present buildings are fully occupied by the machinery now in them, and new engines will necessitate new buildings. The ground needed for this purpose can be obtained by the removal of a dwelling-house; but the vicinity is thickly built over, and in part with wooden houses, rendering the engine-houses liable to destruction by fire originating on neighboring premises. The burning of these buildings, and the consequent injury to the machinery, would deprive the high-service territory of its water supply for a considerable time.

"The situation is such that a satisfactory arrangement of new supply and delivery mains cannot be had; also the cost of operating the present engines is much too great. Engines are now in use in other cities that are doing the same amount of work with an expenditure of only one-third the quantity of coal.

"Parker-Hill reservoir has not the proper elevation for the principal reservoir, or as a source of supply to other reservoirs located at distant points.

"The location is an unfavorable one, on account of the cost of supplying the pumps with water. It will be necessary to convey it to them from the Brookline reservoir, a distance of over two miles, at a large cost for mains, and with a considerable loss of head, that will occasion additional expense for pumping. With the amount of water that is now used the average loss of head is about 10 feet during the day hours, and after the water is pumped, a portion of it is to be conveyed back, with an equal or greater loss, in the direction of, and in the case of Brighton to points beyond, the reservoir.

"The location is also objectionable from the fact that it is so low; the water is received in the pumps under a pressure of over 30 lbs. per square inch, which causes a harsh action of the machinery and greatly impairs its efficiency. To have a smooth action of the pumps the water should be drawn from a well or basin of still water through a short suction main; this condition cannot be secured at Elmwood street, without destroying the head of 70 or 80 feet under which the water is received, and thus increasing, by an equal amount, the height to which it is afterwards to be raised.

"These reasons, and others of less importance, make it desirable to choose another site for the new engines when they shall be required, and the best site is near the Chestnut-Hill reservoir, on land now owned by the city.

"At this point the buildings will be isolated, and may easily be protected from fire; there is plenty of room for future extensions; the water may be received in an open well, without appreciable loss of head, and the coal can be delivered in the coal-house directly from the cars, as the site is on the line of the Woonsocket division of the New York and New England R. R.

"The general character of the distributing system should be the same, wherever the pumping machinery may be located.

"The territory to be supplied consists of various districts, more or less isolated, and with the extreme ones at distances of about six miles from one another, measured either in a westerly or southerly direction. That is, the west end of Brighton and the south end of Dorchester are about six miles from Beacon Hill, and also about six miles from each other.

"Distinct systems of distribution are required for these various areas, involving the use of long connecting mains; and unless reservoirs are used as the centres of distribution these mains should be in duplicate, to prevent, any interruption to the supply from accidents, or while repairs or additions are being made.

"A considerable reservoir capacity is essential for security in case of accidents to the machinery, for furnishing a prompt and liberal supply during large fires, etc., and if this capacity be provided in a number of small reservoirs, rather than in one of larger size, a notable saving will be effected in the cost of the connecting and distributing mains.

"The reservoirs will also maintain a more uniform head or pressure, and will admit of the use of somewhat smaller pipes in the distributing system.

"The scheme of works that I would recommend may be briefly described as follows:—

"A pumping-station near Chestnut-Hill reservoir, provided with two engines, each of capacity to raise 10,000,000 gallons in twenty-four hours, to a height of about 120 feet.

"The water for the supply of the engines to be received in an open well, and to be drawn from the 5-foot pipe which it is proposed to lay around the reservoir to join the Sudbury-river conduit with the 48-inch delivery mains. This pipe can be supplied either from the reservoir, from the Cochituate conduit, or from the Sudbury-river conduit, as may be desired.

"A 30-inch force main leading to a reservoir (No. 1) located upon one of the hills in the vicinity of the pumping-station. This reservoir to have its water surface at an elevation of about 240 feet above tide level, and a capacity of about 15,000,000 gallons.

"A 30-inch supply main from the reservoir passing through Brookline to the corner of Prince and Perkins streets, in West Roxbury, and there branching into two lines of pipes, one 20 inches in diameter running to the Parker-Hill reservoir (No. 2), the other 24 inches in diameter passing to a reservoir (No. 3) so located as to command the supply to Dorchester and neighboring portions of West Roxbury.

"Also a 16-inch supply main running from the main reservoir (No. 1) to Brighton, for the supply of the high lands of that division of the city.

"Reservoir No. 3 to have its water surface at an elevation of about 220 feet, or level with that of Parker Hill, and a capacity of 8 or 10 millions of gallons. From this reservoir a 20-inch main to lead to the Dorchester District.

"The 24-inch main is to supply Jamaica Plain and the western and southern portion of West Roxbury as well as reservoir No. 3.

"This system will command all lands below elevation 170, giving to each house an ample pressure, and will furnish a supply to the lower stories of houses at elevation 200 or 210.

"In West Roxbury there are about 630 acres of land (the summits of various hills) situated above elevation 200, and about 1,250 acres above grade 170.

"Until the exact locations of the reservoirs are decided upon, and surveys and estimates of quantities have been made, it is impossible to give more than a roughly approximate estimate of the cost of the proposed works.

"The following estimate is based upon liberal prices and allowance for contingencies, and will rather exceed than fall short of the more exact one:—

ESTIMATE OF COST.

Engine buildings, wells, engine foundations, supply pipe, etc.	\$120,000 00
Two engines, capacity 10,000,000 gallons each	210,000 00
Lands and reservoir (No. 1), capacity 15,000,000 gallons	200,000 00
Lands and reservoir (No. 3), capacity 10,000,000 gallons	150,000 00
Pipe mains	340,000 00
	<hr/>
	\$1,020,000 00
Superintendence and contingencies	80,000 00
	<hr/>
Total	\$1,100,000 00

"If thought advisable, the first outlay may be somewhat reduced by omitting one engine, a portion of the mains, and the building of reservoir No. 3, though the land for it should be taken at once.

"The estimate thus reduced amounts to \$825,000.

"It should be understood, however, that the expenditure of the balance can be delayed for a few years only; that by the time the work represented by the estimate of \$825,000 is completed, that which is at first omitted should be begun.

"With the extension of the high-service supply pipes that will be made, and the increase of population in the territory supplied that it is fair to suppose will take place, the existing works, even after their enlargement by the laying of new mains, as before indicated, cannot be safely relied upon to furnish an adequate supply for more than three years longer.

"The maximum safe capacity of the old works after the laying of the new mains will be about 2½ million gallons daily, equal to a supply during the months of greatest consumption for a population of about 40,000. There are to-day over 36,000 people living in the territory to be supplied, and the yearly increase of this population has been about 6 per cent. during the last few years. At this rate the total increase, including the growth of 1875, would be over 8,000 before the new works would be put in operation.

"It will require two working seasons to construct new works, and their construction must be authorized by act of legislature.

"After the act is obtained there is required a great deal of preliminary work, in the way of surveys, plans and specifications, etc., before the work can be put under contract; so that very little can be done in actual construction during the following season.

"It will be seen, therefore, that it is important that an early decision should be made as to what shall be done; and, if the plan for new works be adopted, that the necessary legislative action be applied for this winter.

"Even if it should not be decided to begin the preliminary work during the coming year, it is still important, as a matter of economy in the work now going on, that a decision as to what is to be done should be reached at an early day, for the pipes are being rapidly extended through the new districts, and it is impossible to determine what sizes should be used, and through what streets mains and sub-mains should be laid, until some design for the works of the future is adopted.

"At present there are no means of supplying the high lands of Brighton. A long and expensive main is required to connect them with Parker-Hill reservoir, which main would become useless should the proposed new works be built.

"As at best it will be some time before these works can be available, it is necessary to resort to temporary means for the supply of that territory.

"A small masonry reservoir, to be located on Academy Hill, in the school-house yard, can be cheaply built, which may be supplied by small steam-pumps placed at some convenient point, as, for instance, in the fire-engine-house on Chestnut-Hill avenue.

"The reservoir to have a capacity of 30 or 40 thousand gallons, or sufficient for ordinary fires, and an elevation of about 170 feet above tide. The pumps to be two in number, each with a capacity of 200,000 gallons.

"The estimated cost of this work is \$5,500; and I would recommend that it be done early next season, as a large proportion of the most valuable buildings in Brighton are situated above the reach of the low-service supply."

TEMPORARY HIGH-SERVICE SUPPLY FOR BRIGHTON.

In accordance with the recommendation in the foregoing report, the Board, on March 23d, 1876, authorized the City Engineer to construct the necessary works for a temporary supply of Brighton. (For *description* see p. 166.)

On March 28th the following order of the Council was approved by the Mayor : —

" *Ordered*, That the Cochituate Water Board be authorized, with the approval of the Committee on Public Buildings, to occupy temporarily a part of the lot of land in Brighton owned by the city, and forming part of the High School house lot, for the purpose of constructing thereon a reservoir in connection with the temporary high-service supply in Brighton.

PARKER-HILL RESERVOIR.

April 5th, 1873, the Mayor approved an order for application to the Legislature for an act to build Parker-Hill reservoir. This act was obtained May 14th, 1873. (See *Part Fourth*.)

May 19th the Water Board voted to ask the City Council for an appropriation of \$234,000 for the reservoir and the necessary connecting mains.

On June 6th an order was approved appropriating \$161,000 for the proposed reservoir, and authorizing the Water Board to seize land.

On June 12th the Water Board voted to take the necessary steps to build the reservoir, and on June 19th, a committee, consisting of the President and Messrs. E. A. White and W. G. Thacher, were appointed to take charge of the construction.

June 23d the City Engineer was authorized to prepare specifications and advertise for proposals, and on July 29th three bids were received and opened.

On July 30th the contract was awarded to Messrs. Tarbell and Hayes, of Boston, for \$70,287.40.

The Committee on Construction having been authorized by the Board, June 23d, to seize and hire land, proceeded, July 24th, to seize land on Parker Hill belonging to Isaac Hayden and the heirs of John Parker.

Actual work on the reservoir, under the contract, was begun August 11th, and continued until the frost interfered.

On Jan. 1st, 1874, about 20,000 cubic yards of earth had been excavated, and 600 cubic yards of stone collected.

On May 15th, 1874, the Committee on Construction were authorized to seize the right to lay and maintain pipes from the lower end of Fisher avenue to connect with the pipes from Parker-Hill reservoir.

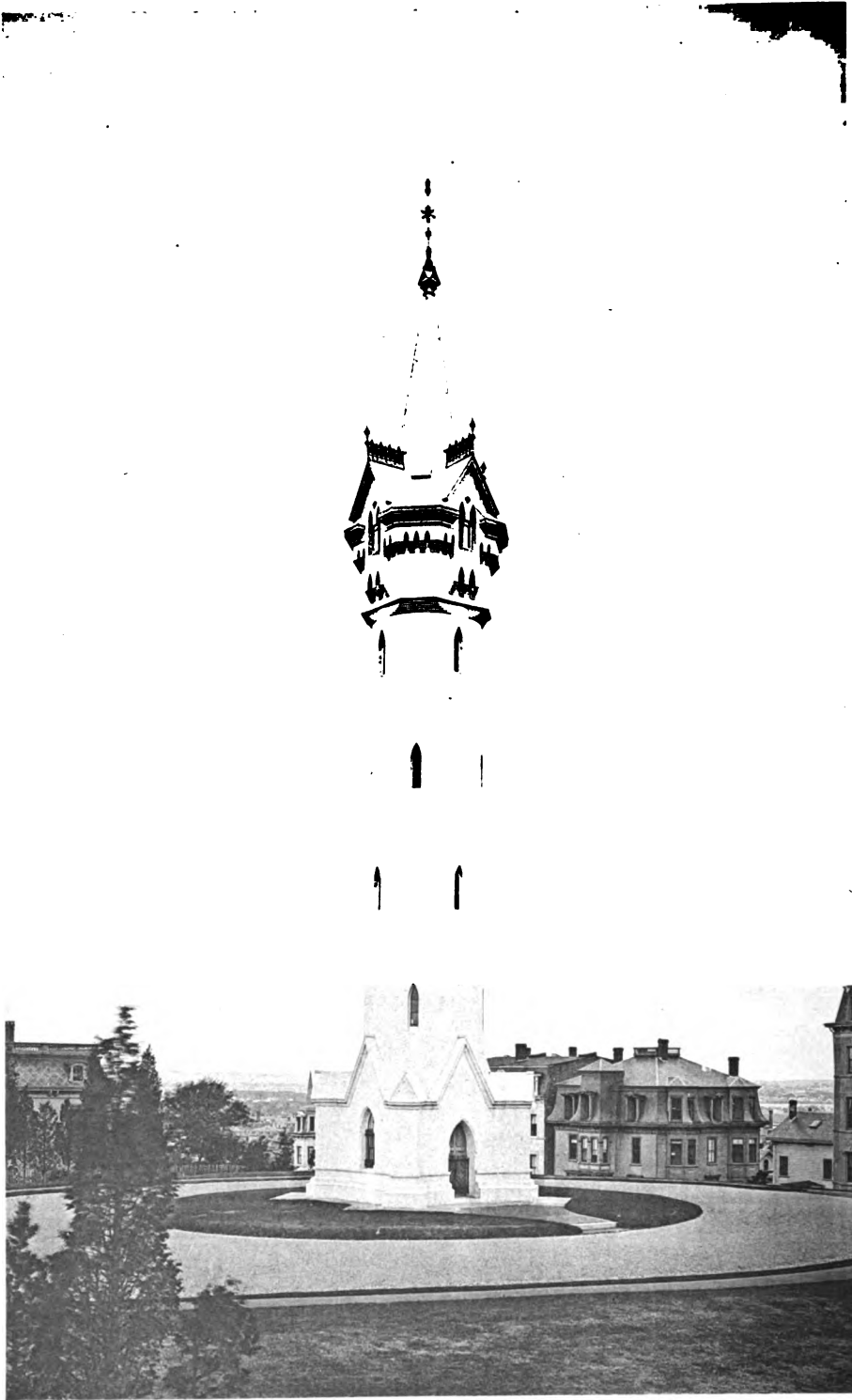
On May 27th the Board passed a vote of thanks to the Fisher family for their generosity in allowing pipes to be laid in Fisher avenue, Parker Hill, without compensation.

The work of construction went on rapidly during the season of 1874, and on November 2d water was let on, in presence of the Mayor, members of the City Government, the Water Board, and others. Mr. N. J. Bradlee, ex-President of the Water Board, was present, and gave the order for letting on the water.

In October a plan for a gate-house was adopted, and on October 15th the contract for its construction was let. The gate-house was built during the winter, and accepted May 24th, 1875.

On March 4th, 1875, the reservoir having been completed, the special committee for its construction was dissolved.

The total cost of Parker Hill reservoir, including land, has been \$228,246.17, a little less than the first estimate.



ROBLEY STAND PIER.



DESCRIPTION OF THE HIGH-SERVICE WORKS.

The water for the high service is taken from the 24-inch Dorchester main on Pyncheon street, near its junction with the 36-inch main on Tremont street.

The supply main to the pumps consists of a 16-inch pipe, which passes from its junction with the 24-inch main through the yard of the police station in the rear of the engine-house, thence under the coal-shed and boiler-room to the engines. The distance is about 225 feet. A three-way branch and two 16-inch gates regulate the flow so that either or both pumps may be supplied. The engine-house is a plain brick building, and is situated on Elmwood street.

A portion of the station-house lot, 3,431 square feet, was set off by the City Council for the use of the Water Board, and 2,132 feet were bought of other parties, giving a lot of 5,563 square feet, an area sufficient for the engine-house, boiler-house and coal-shed. The frontage of the lot is 40 feet.

In the engine-house are two double-acting pumps worked by two non-condensing and direct-acting engines.

Diameter of steam cylinders, 20 inches; stroke, 36 inches.

The engines have heavy fly-wheels, 15 feet diameter. Distance from centre of fly-wheel shaft to centre of steam cylinder, 13 feet $2\frac{1}{2}$ inches. From centre of steam cylinder to centre of pumps, 8 feet 8 inches.

Each engine is supplied with steam from a vertical tubular boiler, 7 feet in diameter. The tubes are $2\frac{1}{2}$ inches in diameter and 10 feet long.

Each pump has a capacity to pump 2,400,000 gallons in 24 hours, when making 35 revolutions per minute, or 48 gallons per revolution. The supply from the 16-inch pipe comes to the pistons under a pressure of about 33 pounds per square inch, which exerts a harsh action on the machinery and to a certain extent impairs its efficiency. The velocity of the column of water in this supply-pipe, when the engines are making 35 revolutions per minute, is at the rate of 156 feet per minute. The shock produced by the stoppage of this column 70 times a minute is very great, and it is found necessary to connect the supply line with a large air-chamber. The harsh motion has been still further lessened by the application of stronger and stiffer springs to the pump valves. It is also found that on account of the connections of the engines through the supply and force mains they react upon each other when working together.*

* The capacity of one engine is less than four steam fire engines. The latter will throw on an average 450 gallons per minute.

The machinery was designed by Mr. Chas. Carr, of the Boston Machine Co. They were accepted after a careful examination by Mr. E. S. Cheshbrough and Mr. Albert Betteley. The cost of the engines and pumps was \$37,000. They were put in operation February 25, 1870. (See "History of the High Service.")

A 16-inch pipe leads from each engine, and by means of a Y branch connects with the single force main which leads to the stand-pipe, just outside the engine-house. Each of these pipes between the engine and the Y is provided with a check-valve. The single 16-inch force main passes from the Y through Elmwood street, across Roxbury street, passing under the 24-inch and the 12-inch, through Gardner and Centre streets and Fort avenue to the stand-pipe. The length of the force main is 2,500 feet.

The arrangement of the branches and gates is such that the water can be pumped past the stand-pipe directly into the distribution-pipes. The stand-pipe was built on the site of the old Revolutionary Fort in "Roxbury Highlands."

The highest point of the natural ground, a rock formation, was 157 feet above tide-marsh level. The grade of the highest point of the old fort earth-work was 163.

The stand-pipe consists of a boiler iron shell, 5 feet in diameter and 80 feet in length. This pipe is enclosed by a handsome circular structure of brick-work with granite trimmings.

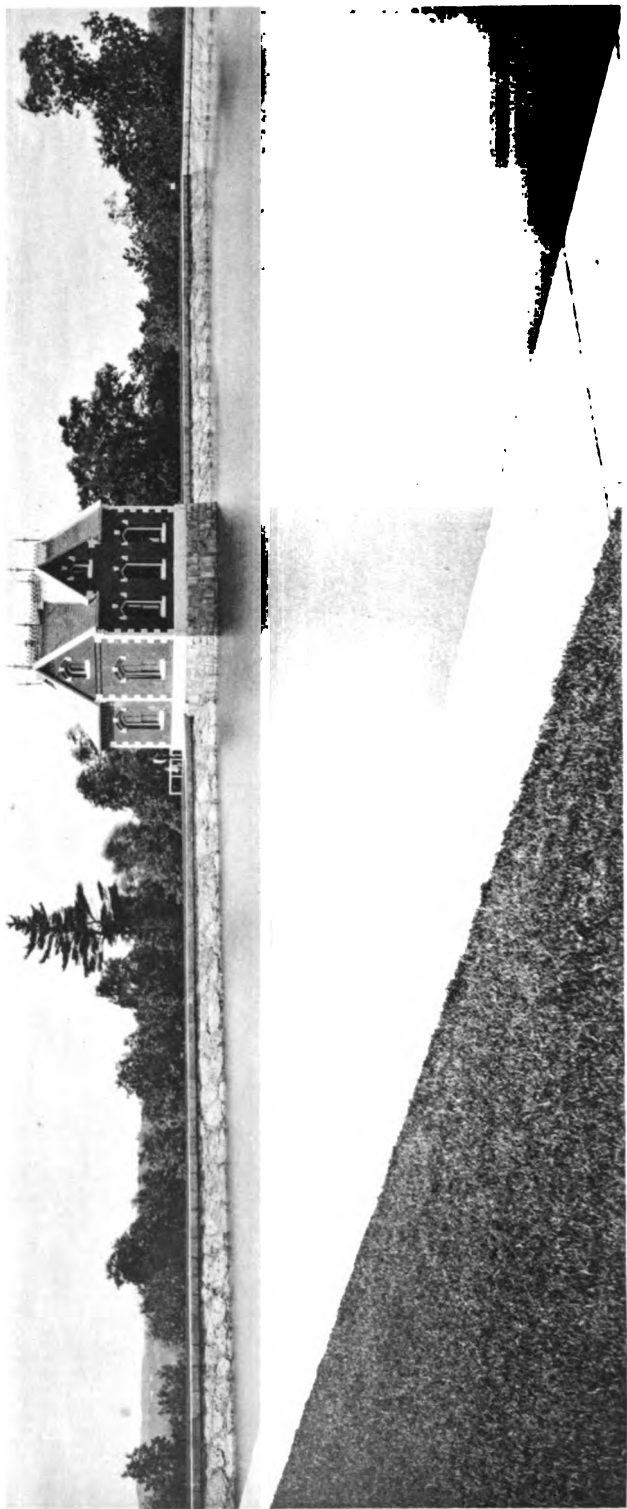
There is a 3-feet space between the interior pipe and the outer wall, which is occupied by a spiral staircase leading to the look-out at the top. The floor of the look-out is 3 feet below the top of the pipe.

The exterior, at the base, is finished with four pediments, with buttresses at the angles. The circular wall, 15 feet 1 inch in diameter at the bottom and 13 feet 10 $\frac{1}{4}$ inches at the top, is unbroken (except by the windows) to within 10 feet of the roof, where it projects in an octagonal form and is crowned with a steeple. The total height is 133 feet.

The handsome proportions of this stand-pipe and the thoroughness of the work, combine to place it in the foreground of such structures. The exterior is painted white, and is a marked object from the surrounding country.

The contract for the iron-work was let to the Boston Machine Co.

The masonry was built by Messrs. Standish and Woodbury.



about to apply the law
and be an arbitrator.
The Secretary of Peace
and Justice is a man of
the world.

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the authors, the χ^2 test indicates that the observed frequency of 100 is significantly greater than the expected frequency of 44.1.

4. $\frac{1}{2} \frac{d}{dt} \int_{\mathbb{R}^n} |u|^2 dx = 0$ (conservation of mass).

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and so, χ_1 and χ_2 are linearly independent.

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A. J. Auer

2017-01-10

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• A symposium is held to celebrate

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It was built partly by slaves and partly by convicts.

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1 foot in width and 1 foot in height.

PARKER-HILL RESERVOIR.

This reservoir was built to supply the high-service system with storage water to meet a sudden demand greater than could be met by the pumps. It is situated nearly on the summit of Parker Hill, in the Highland District, one of the highest hills overlooking the city. It is about three miles from the State House.

It holds 7,200,000 gallons above a plane $2\frac{1}{2}$ feet above the bottom of the outflow pipe.

The area of the water surface at high water is 1.47 acres.

The depth at the foot of the paved slopes is 22 feet.

In the centre the depth is 24 feet.

The general form of the reservoir is rectangular, somewhat smaller at one end than the other, and bounded on the other two sides by curved lines of long radii.

The north and south sides are each 290.06 feet in length. The east end is 196.06 feet long, and the west end 253.54 feet. These distances are measured on the inside of the coping.

The area of the lot of land on which the basin is constructed is 197,614 square feet. An additional piece 25 feet wide, extending to Fisher avenue, contains 2,887 square feet.

The soil was a hard clay gravel, almost impervious, but it was determined, after careful experiment, to line the bottom with 2 feet of puddle made from material found in excavation, and the sides with 2 feet of clay puddle.

The general lining of the sides of the reservoir is 4 feet in thickness, made up of the following courses: Clay puddle, 2 feet; broken stone, 8 inches; paving of Roxbury stone, 16 inches. For a distance of 6 inches from the face this paving is laid in cement mortar.

The lining abuts on a concrete wall 3 feet by 1 foot at the bottom. For the lower 5 feet the paving blocks are 20 inches thick, and the puddle 2 feet 4 inches in depth.

The reservoir was built partly in excavation and partly in embankment, the lines being fitted to the contours of the surface.

The embankments were built up in layers, sprinkled and rolled. They are 21 feet 10 inches in width, including coping.

The slope of the paving inside is $1\frac{1}{2}$ to 1.

The outside slopes are $1\frac{3}{4}$ to 1, well turfed.

There is a granite flagging at the top forming a walk all around the reservoir 5 feet in width and 1 foot thick.

A driveway 25 feet wide extends around three sides of the reservoir, connecting with Parker-Hill avenue.

The views of the city and surrounding country from this elevation are very fine.

The Gate-house is nearly in the centre of the southerly side.

The foundation course is a bed of concrete 18 inches thick, 33 feet $1\frac{1}{2}$ inches wide by 34 feet $11\frac{1}{4}$ inches front. In addition to this thickness there are 4 channels, 20 inches square, of concrete running parallel with the front face of the gate-house. They are cut down into the bottom as a precaution against leakage. The walls are all started on this concrete, and are of the following thicknesses at the base:—

Front wall, 6 feet $7\frac{1}{2}$ inches.

Rear and side walls, 5 feet $5\frac{1}{2}$ inches.

The front wall is 3 feet thick at the top. The others are 2 feet 9 inches. They are all built of first-class rubble granite masonry laid in cement mortar.

The size of the floor at top of walls is 29 feet 6 inches front by 26 feet 9 inches wide.

This space is divided into three compartments by two cross walls; one extending the whole distance across the building transversely, and the other to within 6 feet of the front wall, where it turns and joins the first named cross wall. These walls are vertical and $3\frac{1}{2}$ feet thick.

The chambers are called the Inlet Chamber, the Outlet Chamber, and the Drain Chamber.

The bottoms of the chambers are all paved with granite blocks 18 inches thick. Where the stop planks come a cut stone is introduced whose surface is 3 inches above the paving.

The Inlet Chamber, which is the most westerly one, is 6 feet by 19 feet, below the offset, and 7 feet by 21 feet at the floor level.

Attached to the 36-inch inlet pipe, which enters at the bottom, is a float for regulating the height of the water automatically.

Between this float and the reservoir side of the chamber, a set of stop planks is provided.

The grooves are 6 inches wide.

From the wall on the reservoir side of this chamber, and at the same level with the inlet pipe, a 30-inch pipe is continued to the centre of the reservoir, where it discharges on a stone apron. A gate inside the gate-house controls this pipe.

There is a low level opening into the outlet chamber controlled by a

PARKER HILL RESERVOIR

Plan and Section of the Reservoir

way 25 feet wide extends around the sides of the building, with Park Hill Avenue.

The view of the city and surrounding country from this corner is fine.

At the base of the masonry in the centre of the square is the

foundation of the base is a bed of concrete 18 inches thick, 100 feet square, and 11½ inches deep. The bottom of this is a square of concrete running parallel to the sides of the house. They are cut down into the bed of the concrete. The walls are all started on this foundation of the following thicknesses at the base:—

The front wall, 6 feet 7½ inches.

The side and side walls, 5 to 15½ inches.

The front wall is 31½ feet thick at the top. The others are 2 feet thick at the top. The walls are built of granite masonry, 100 feet square.

The top of the walls is 29 feet 6 inches square.

The walls are divided into three compartments by two cross walls, one running across the building transversely, and the other running across the front wall, where it turns and joins the side wall. These walls are vertical and 3½ feet thick.

The compartments are called the Inlet Chamber, the Outlet Chamber, and the Reservoir Chamber.

The bottoms of the compartments are all paved with granite blocks 3 feet thick. Where the top planks come in, the stone is introduced, and the face is 3 inches above the paving.

The Inlet Chamber, which is the most westerly one, is 6 feet below the street, and 7 feet by 21 feet at the floor level.

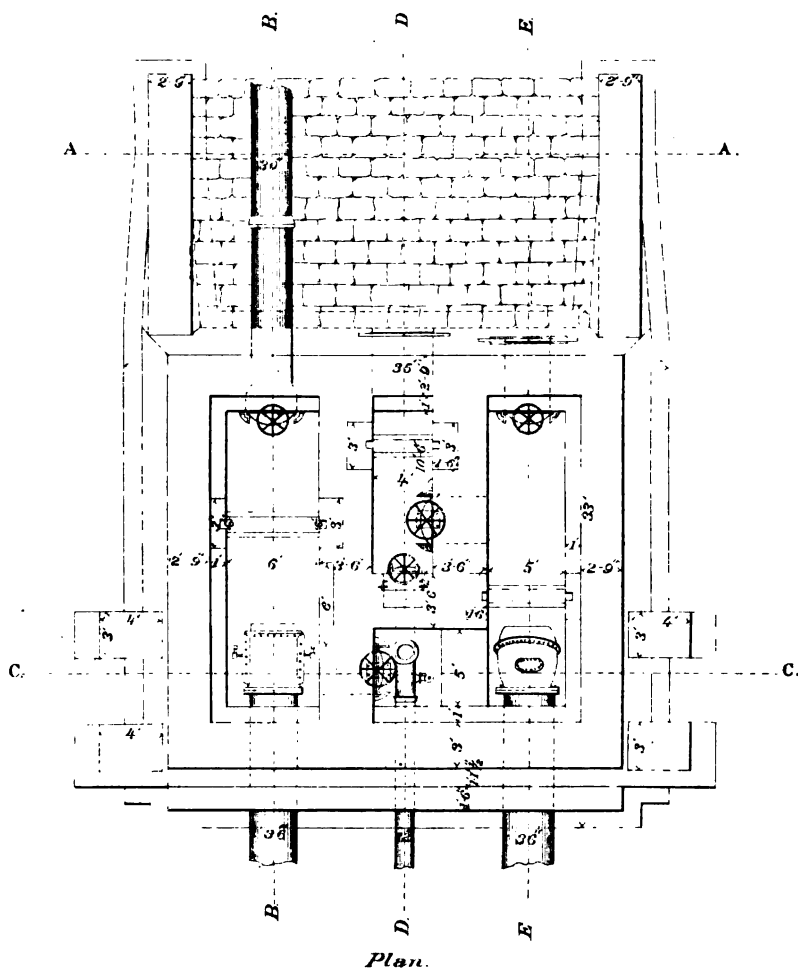
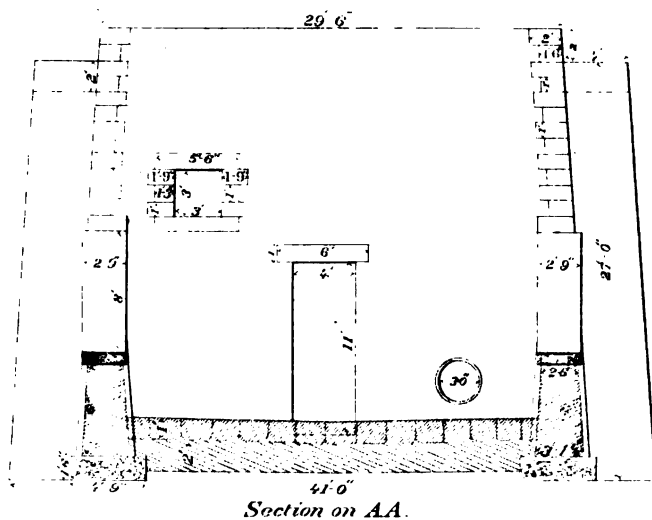
A 36-inch inlet pipe, which enters at the bottom, runs up the height of the water automaticity.

Between this floor and the reservoir side of the chamber, the planks are 10 feet wide.

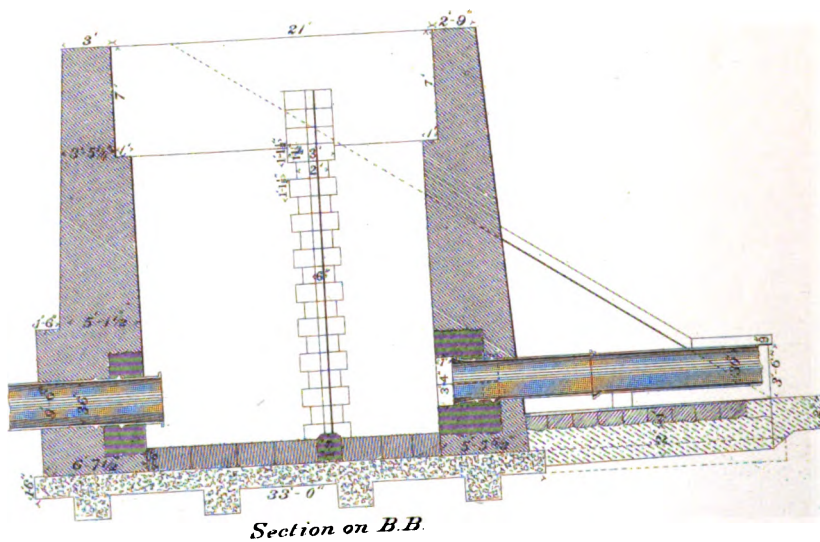
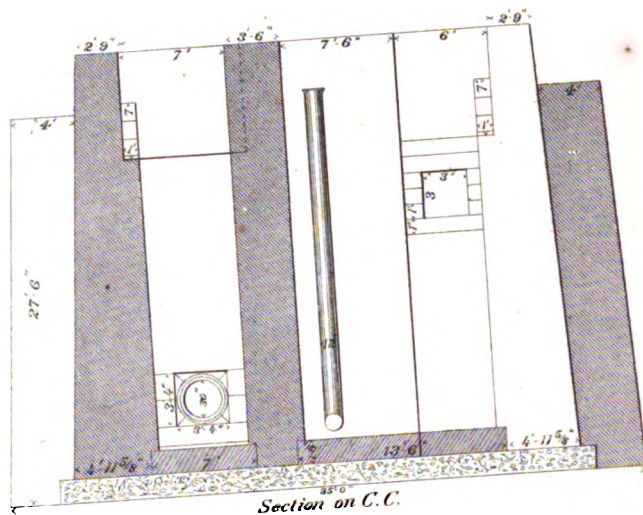
The ground is 6 inches wide.

From the reservoir side of this chamber, a 39-inch level water pipe, a 39-inch pipe is continued to the reservoir, where it discharges on a stone apron. A gate inside the house controls the pipe.

There is a 10-foot opening into the outlet chamber, and



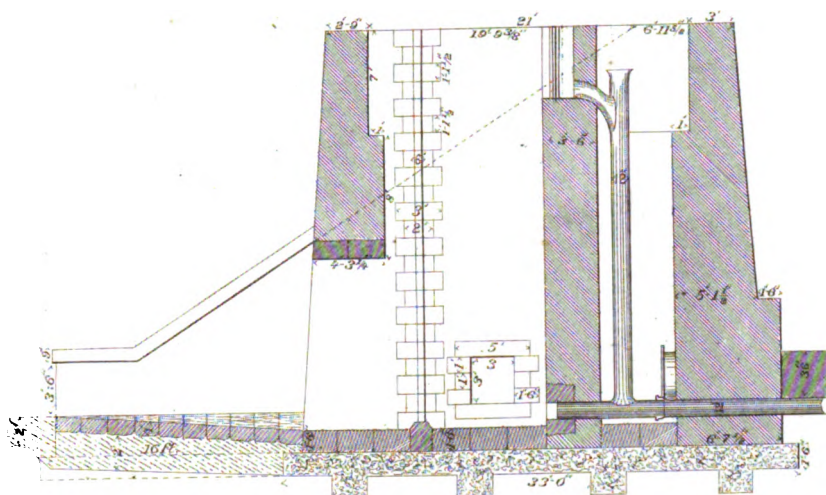
PARKER HILL RESERVOIR
Plan and Sections of Gate House.



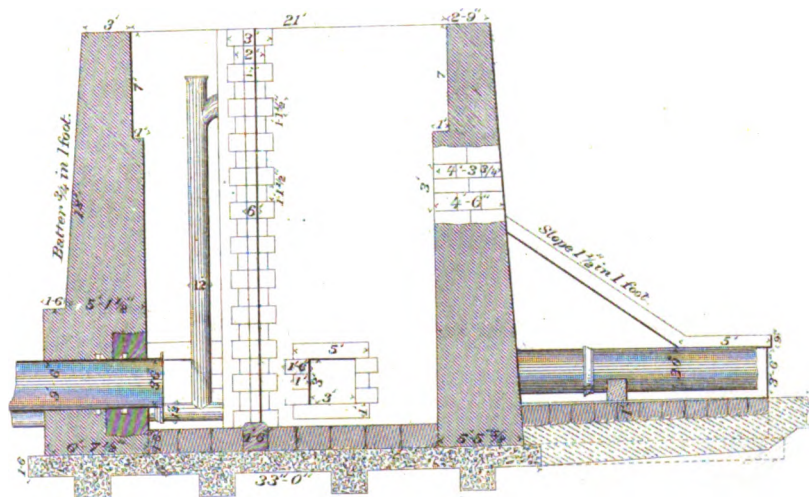
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S. 1000



Section on D.D.



Section on E.E.

gate, so that the water may be pumped directly through the two chambers without passing into the reservoir.

The Outlet Chamber is 5 feet by 19 feet below the offset, and 6 feet by 21 feet at the floor level. The 36-inch outlet pipe is near the bottom.

The 12-inch iron drain-pipe passes through this chamber, and is provided with two small gates to drain this and the inlet chamber at its lowest level.

This pipe rises vertically to high-water mark. It is open at the top, affording an overflow when the water is passing through the gate-house only.

This overflow is 23 feet above the paving.

The chamber is provided with a set of stop-planks in front of the outlet pipe.

There is but one direct opening from the reservoir into the outlet chamber. It is 3 feet square, and controlled by a gate.

The bottom of the opening is 14 feet above the paving.

Another gate, 3 feet by 3 feet, connects this chamber with the drain chamber at a low level, viz. : 18 inches above the paving. The other, opening into the inlet chamber, has already been alluded to. By this arrangement the water can be drawn from any level in the basin.

The Drain Chamber is 4 feet by $11\frac{1}{2}$ feet at the level of the floor, and 4 feet by $10\frac{1}{2}$ feet below the offset. It has a rectangular opening into the reservoir 4 feet by 11 feet. The bottom of the opening is level with the paving. The drain-pipe has an opening at the bottom, controlled by a gate from the upper floor level, and also an overflow at the top, regulated within a range of a few feet by stop-planks inserted in a recess in the wall in front of the pipe. The level of this overflow is twenty-one feet above the paving. The opening into the outlet-chamber has been already mentioned. There is a set of stop-planks in this chamber near the reservoir opening. The drain-pipe connects with the low service.

The level of the top of the walls to the gate-house, on which the superstructure is built, is 26 feet above the paving. There are two spur walls on each side of the gate-house, around and between which the puddle is packed. They are 3 feet by 4 feet. The front one is simply the front wall extended, and the other is 4 feet further back. These walls are to prevent any water from following along the wall between the masonry and the embankment.

Where the iron pipes run through the bank and masonry walls they are provided with flanges.

The Wing Walls.—The banks are kept away from the reservoir front of the gate-house by means of two wing walls which extend into the reservoir. They are 16 feet long beyond the base of the wall. They are founded on a bed of concrete, which is put in at the same level with the concrete under the gate-house. The rubble wings are finished off 2 feet 6 inches on top, and are capped with a 2 feet 9 inch cope. The space between the wings is paved with granite blocks 1 foot thick, laid on 2 feet of clay puddle, which is an extension of the same bed which covers the bottom.

Supply-Pipe.—The supply-pipe at present (1876) consists of a 24-inch main, connecting with the 16-inch rising main to the stand-pipe, at Cedar street. The route lies through Centre, New Heath and Parker streets, and then through Fisher avenue to the reservoir.

Grades.—

High water	219	feet above tide-marsh level.
Top of banks	222	“ “ “ “
Bottom of inlet and outlet pipes,	197.50	“ “ “ “
Sills for stop-planks	196.25	“ “ “ “
Lower floor of gate-house	196	“ “ “ “

The superstructure is of bricks laid in red mortar, with granite trimmings and a heavy cut granite base. It is an ornamental structure, designed by L. Fred. Rice, architect, and built in a thorough manner, by J. W. Coburn & Co. Messrs. Tarbell & Hayes were the contractors for the reservoir. The gates and machinery were built by the Boston Machine Company. The construction was under the charge of Mr. Wilbur F. Learned, of the City Engineer's office.

Materials and Cost.—The total cost of the reservoir, exclusive of the land damages, was \$141,317.26.*

The cost of the reservoir, exclusive of the gates, superstructure, engineering, etc., was \$78,561.31, distributed as follows:—

48,202 cu.yds. earth excavation,	at \$	.58
1,428 “ soiling,	“	45
1,215 “ clay delivered,	“	2 25
2,822 “ puddle mixed in mill,	“	1 75
3,198 “ “ “ place,	“	87
1,387 “ broken stone,	“	2 12

* Including land damages, the total cost was \$228,246.17.

DESCRIPTION OF THE HIGH-SERVICE WORKS.

165

178 cu.yds.	concrete,	.	.	.	.	.	at	\$7 37
1,612 "	Roxb'ry stone slope paving,	.	.	.	.	.	"	6 75
231 "	granite slope paving,	.	.	.	.	.	"	9 87
1,068 sq.feet	" floor paving,	.	.	.	.	.	"	12 00
616 cu.yds.	rubble masonry,	.	.	.	.	.	"	10 00
44 "	cut stone,	.	.	.	.	.	"	40 00
3 "	dressed coping,	.	.	.	.	.	"	27 50
5,334 sq.feet	granite flagging,	.	.	.	.	.	"	2 25
189 lin.feet	laying 36-inch pipe,	.	.	.	.	.	"	2 37
108 "	" 30-inch "	.	.	.	.	.	"	1 98
122 "	" 12-inch "	.	.	.	.	.	"	1 20

Total, . . . \$78,561.31

DESCRIPTION OF THE TEMPORARY WORKS FOR THE SUPPLY OF THE HIGH SERVICE AT BRIGHTON.

The high service of Brighton is temporarily supplied by means of two small pumps and a reservoir.

The pumps are located on the city ledge lot on Cambridge street, midway between North Beacon and Warren streets. They take their supply from one side of a gate in the 12-inch pipe in Cambridge street, and deliver into the same pipe on the other side of the gate. The pumps are of the Worthington duplex high-pressure type. They have 12-inch steam cylinders, 7-inch water cylinders, and have a 10-inch stroke, with a delivery of 1.74 gallons per stroke. Steam is supplied from two upright tubular boilers of 42-inch diameter. They were put in operation Aug. 10, 1876.

The lift of water is about 110 feet, not allowing for back pressure. The force main continues through Cambridge and Washington streets and Chestnut-Hill avenue to a private way leading to the High School lot, on which the reservoir is located. An 8-inch pipe forms the connection from the street main to the reservoir. This structure holds about 48,000 gallons. It is built of masonry walls 10 feet high and 5 feet thick at the base, resting on a concrete foundation. The concrete extends over the bottom, and the whole is lined with a layer of bricks and covered with a wooden roof.

HISTORY AND DESCRIPTION OF CHESTNUT-HILL RESERVOIR.

HISTORY OF CHESTNUT-HILL RESERVOIR.

1862.

The first mention of a new storage reservoir for the city will be found in the annual report of the Water Board for 1862. They recommended that one should be built whenever "the affairs of our country are in a more prosperous condition."

1863.

October 21st. The subject was brought directly before the Board, and a committee was chosen to select a site.

1864.

September 19th. The City Engineer, Mr. N. Henry Crafts, made a report accompanied by two plans of location, one of which was the present site, the other a tract of about 50 acres between Chestnut Hill and Webber's barn. The first was unanimously selected.

October 17th. The City Council requested the Mayor to petition the Legislature for an act.

1865.

April 4th. The Governor signed an "Act to Authorize the Construction of an Additional Reservoir." (See *Part Fourth*.)

April 10th. The Water Board was authorized by the Council to purchase not exceeding 200 acres, in Newton, Brighton and Brookline.

April 26th. The following committees were appointed by the Board: On the purchase of land, Messrs. Norcross, Dennie, Wadsworth and Fitch. On construction, Messrs. Norcross, Standish, Bradlee and Thorndike.

May 9th. It was voted by the Board that the name of the reservoir be the Chestnut-Hill reservoir.

July 11th. The first purchase of land was made.*

November 10th. The Board was authorized to include the Lawrence meadow.

November 17th. The Mayor signed an order appropriating \$900,000† for the construction of the reservoir.

Some preliminary work was done before the close of the year.

* The total amount bought was 212 acres, 2 qrs., 34 rods, 233 feet.

† This amount was increased from time to time to \$2,449,982.07 its total cost.

1866.

February 14th. Mr. Henry M. Wightman,* who had made the surveys for the reservoir, was appointed Resident Engineer.

Mr. Edward F. Knowlton, who had been appointed Superintendent, died March 12th, and on March 26th Mr. Albert Stanwood was elected Superintendent.

The first work done with teams was on April 25th. The bank on the Lawrence meadow was begun May 15th. The same gentlemen continued to take charge of the construction, with this exception,—Mr. Benjamin F. Stevens was substituted for Mr. Dennie, whose term had expired.

August 27th. A boiler used on the works exploded during the absence of the engineman. No harm was done.

October 8th. The City Council authorized the construction of the driveway. Considerable progress was made during the year. Temporary buildings were erected for the accommodation of a portion of the men employed upon the works, and stables for the horses and oxen.

Contracts were made with B. F. Ricker, for teams, and with Learned & Shaw for boarding the men for one year, also with S. S. Rowe for laying slope walls. Most of the work was done by the day.

During the winter much was removed from the Lawrence basin, ledges blasted, and the retaining-wall built on the driveway.

1867.

March 2d. 225 laborers employed on the works struck for higher wages. They had given no previous intimation of their intention. They were all promptly discharged and new men employed within three days.

In the early part of March, the Board, with Messrs. Crafts and Wightman, visited New York, Brooklyn, Philadelphia, Baltimore and Washington, for an examination of the water works of those cities.

April 5th. Messrs. Thorndike, Standish and Bradlee were chosen a Committee on Construction.

During the year 1867 the work was prosecuted with great vigor. Contracts were made with Messrs. Broad & Ward for granite capping for the

* The engineering force on this reservoir consisted, for the larger portion of the time, of the resident engineer, one assistant, two rodmen and one axeman. The amount of engineering work done was very large; lines and grades for every piece of embankment, for every wall, for the gate-houses, the driveway, etc., had to be constantly given, to say nothing of the detailed office plans. Even before the arrangement of construction, the exact boundary lines of all the separate estates within the proposed territory had to be accurately determined. After this was done a complete topographical or contour map was made, showing the levels of the original surface and the lines and grades of the proposed works.

slope walls; with Hugh McGuiness and others for the puddling clay; with O. T. Rogers & Co. for the hammered granite.*

The brick sewer was begun May 10th and completed November 27th. Extensive surveys were made for the best route for the main pipes from the reservoir, during the fall and winter of this year and the spring of

1868.

The Committee on Construction consisted of the president and Messrs. Wadsworth and Lewis.

An appropriation was made in April for 48-inch pipe.

Work was concentrated as much as possible during this year on the Lawrence basin. 400 feet of the conduit, where it crossed between the two basins, was removed and the water carried around in the mean time through a flume to keep up the supply to the Brookline reservoir. The old embankment on which this piece of aqueduct was built was of clay, and, having settled, the brick-work was badly cracked. The new conduit was built on masonry going to the rock. The foundations for the intermediate gate-house were put in during the summer.

On Monday, October 26th, the Lawrence basin was so far completed that water was let in at twenty minutes of eleven, in presence of the Water Board, members of the City Government, and others. Three hearty cheers were given by the five hundred laborers who were crowded on the bank. The day before (Sunday) was the anniversary of the first letting on of Cochituate water.

Mr. Nathaniel J. Bradlee, in a speech delivered on this occasion, stated that there had been removed from this basin over 240,000 cubic yards of material, and there had been laid nearly 15,000 square yards of slope wall and 14,000 square yards of rip-rap wall.

Water was allowed to flow in for 16 days, when the basin was half filled; the gates were then closed, as a leak was discovered in the dam between the two basins. This dam was strengthened by the addition of a puddle trench and a widening from 60 to 80 feet.

This trench was 10 feet in width, carried to the rock. In its centre was placed a tooth wall of brick 18 inches square and 400 feet long.

December 16th. The subject of a gateway was left to the Committee on Construction.

* The history of Chestnut-Hill Reservoir, up to this date, has been taken from Mr. Bradlee's history of the Water Works.

1869.

January 11th. Excavation begun on the 48-inch pipe route.

February 15th. A violent flood delayed the work, inundating the foundation of the effluent gate-house, which was filled with 20 feet of water. Several days were occupied by steam fire engines from the city, aided by a Gwynn pump, in pumping out the water and freeing the engines and pumps which had been covered.

June 11th. A severe accident happened to Mr. Wilbur F. Learned, who was engaged giving a line at the effluent gate-house. He fell from the wall, a distance of about 20 feet, causing such injuries that he was disabled for a period of six months.*

August 12th. The first stone of the effluent gate-house was laid.

November 2d. The 48-inch main was completed and connected with the mains running from Brookline reservoir.

During the winter a large force was employed in removing material from the site of the Bradlee basin. This was used to fill the "Dowse meadow," so called.

1870.

The Committee on Construction consisted of the President and Messrs. Lewis and Allen.

October 19th. By a vote of the Board the lower basin was called the Bradlee basin.

October 25th. The water was let into the Bradlee basin, which was the practical completion of this great work.

This event took place on the 22d anniversary of the introduction of Cochituate water into the city.

Water was allowed to flow in during a portion of each day until November 2, when the low stage of the lake required its cessation until March 14, 1871, when all the water not needed for consumption was allowed to flow into the basin. On May 1st the depth of water was 14 feet 2 inches.

*Mr. Wightman was obliged twice to change his assistants, once by the illness and subsequent death of Samuel C. Horn, and the second time by the accident above alluded to.

DESCRIPTION OF CHESTNUT-HILL RESERVOIR.

THE SITE

is a natural basin at a distance of about five and one-half miles from the centre of the city, and within the present municipal limits. At the time of its construction the land was situated in the towns of Brighton and Newton. Beacon street, which ran directly across the valley, was turned from its course to allow the building of the reservoir. The spot is a beautiful one. There are hills around the basin, particularly on the westerly side, from which fine views may be had of its winding, graceful lines and its sparkling sheets of water. An artificial bank was required only on the lower side of the valley.

FORM.

The reservoir is built in two parts, separated by a water-tight dam. A gate-house in the centre allows of communication between the two basins. Both parts are of somewhat irregular form. Together they are $2\frac{1}{2}$ miles in circumference.

The land bought by the city for this reservoir amounted to $212\frac{1}{2}$ acres.

The combined capacity of both basins is 731,472,429 gallons.

The easterly and the larger of the two basins is called

THE BRADLEE BASIN.

When full, its water area is $87\frac{1}{2}$ acres.

Average depth of water, 20 feet.

Its capacity is 550,583,485 gallons.

On the easterly side of the reservoir, and on the highest part of the embankment, is the principal or effluent gate-house. It fronts on Beacon street.

THE LAWRENCE BASIN

has a water area of $37\frac{1}{2}$ acres, and a capacity of 180,888,944 gallons.

The distance around the centre of the path which surrounds the Lawrence basin is 6,183 feet, or 1.17 miles.

GRAVEL PATH.

There is a gravel path around both basins 8 feet wide, with 6 feet of sodding on each side.

THE DRIVEWAY

proper extends only around the northerly side of the reservoir, though Beacon street completes the circuit, and forms a driveway all around both basins. Beginning at the entrance arch on Chestnut-Hill avenue, the driveway is some 30 feet above the surface of the water, but it gradually drops as it winds around, until by the time the Lawrence basin is reached the roadway is nearly on a level with the reservoir. Its length is 1.7 miles, and if Beacon street is included in the drive, the distance is two and one half miles.

The width varies from 60 to 80 feet.

It is a macadamized road, kept in the best order. The scenery is pleasantly diversified, sometimes by glimpses of the beautiful deep blue water, and again by groves of trees and plots of green grass.

THE ARTIFICIAL DAM,

forming part of the Bradlee basin, is 2,000 feet in length. It is 20 feet wide on top, and in one place 150 feet wide at the base. The greatest height, near the effluent gate-house, is 35 feet. In the centre of this bank is a puddle wall 10 feet thick at the base and 4 feet at the top, founded on the rock. It is built of clay from the neighborhood of Cambridge, mixed with material found near the spot. There is a brick tooth wall in the centre, 18 inches square, laid on the rock, added as an additional precaution against leakage. The surface of the rock was very irregular. The earth of which the main part of the dam was built was put on in layers and well watered and rolled.

THE STONE LINING

of the reservoir is built of dry rubble masonry $2\frac{1}{2}$ feet thick. It is laid on the water side to protect the banks from wash, and is capped with granite blocks whose top is 3 feet $4\frac{1}{4}$ inches below the top of the walk. It extends $19\frac{1}{2}$ feet measured on the slope, or $8\frac{1}{2}$ feet measured vertically. Then there is a berme of 5 feet, and from here a stone rip-rap covers the slope, "three to one," into the reservoir.

THE EFFLUENT GATE-HOUSE,

already referred to, is the most important structure on the reservoir grounds. A bed of quicksand, 28 feet in depth, rendered the laying of the foundations a difficult task. Rubble piers with brick arches rest on the

bed rock and support the structure. These were levelled off on top with a layer of concrete, and a heavy bulkhead, side walls, brick piers and groined arches complete the remainder of the substructure. On the water side of the bulkhead are four separate compartments for four lines of 48-inch pipes. Each compartment has places for a double set of stop-planks, a revolving screen, sluice-gates, and an open well in front of the pipe. The superstructure is built of hammered granite. Outside of the bulk-head are stopcocks placed in the pipes. The wing walls on the water side are not founded directly on the rock, but are placed on piles.

Branch walls were built into the bank 80 feet long on one side, 25 feet on the other. Their section consists of 4 feet of rubble wall laid in cement, and 2 feet of brick-work.

Outside of this gate-house is a brick chamber underground, which contains two gates. These control two lines of drain-pipes, which run through the embankment on arches. They connect with each basin, so that either can be drawn to its lowest level for cleaning or repairs.

Two hydraulic sluice-gates worked by a hydrostatic press were placed in position during the winter of 1873-4 in this gate-house. They are to shut off or let on the water to the 48-inch main. The need of gates at this point, that can be quickly operated, has been felt ever since the reservoir was first used, and provision had been made for them when the gate-house was constructed. They have been designed with special reference to easy and rapid movement. One man can fully open either of them in less than four minutes, and they close by their own weight in less than twenty seconds, settling to their seats quietly. The openings are 48 inches square. The movement is vertical. When in motion the gates are carried on three pairs of wheels, 12 inches in diameter. The seats are not exactly parallel to the gate-frame, being inclined slightly from the vertical, so that when the gate is closed, the gate face and seat are in contact, and the wheels are lifted a fraction of an inch from their tracks. Vertically over each gate is a cylinder fitted with a piston 8-inch diameter and 4-feet stroke. The gates are held in any position by a friction clutch. The height of water in the reservoir is recorded by a float-gauge.

THE INTERMEDIATE GATE-HOUSE,

built in the centre of the dam separating the two basins, is also located directly over the aqueduct, which runs lengthwise through the dam and continues to Brookline reservoir. Four gates, one towards each basin and one on each end of the aqueduct, allow of turning the water any or

all ways. Besides these there are two lower level gates connecting the two basins. There is also in one corner of this gate-house, a gate communicating with a line of drain-pipe laid through the Bradlee basin. The superstructure is of hammered granite, corresponding with the rest of the work.

THE INFLUENT GATE-HOUSE,

at the Lawrence basin, is the smallest of the three structures. It covers one gate that controls a connection between the aqueduct (which curves around one side of this part of the reservoir) and the basin.

A short piece of brick aqueduct, 4 feet by 4 feet 4 inches, connects the two. In the rear of the gate-house, at one side of the driveway, and directly over the aqueduct, provision has been made for inserting stop-planks.

THE SEWER,

built to carry off the drainage of the valley, in order to keep it from entering the reservoir, is of brick-work. Its total length is 7,980 feet, and there were employed in its construction 1,367,000 bricks and 4,300 barrels of cement. It commences on the northerly side of the Lawrence basin, and extends entirely around the westerly, southerly and easterly sides, continuing a short distance beyond the junction of Beacon street and Brighton street. It is of the following sizes :—

283	feet of	6 feet by 6 feet 4 inches.
482	“ “	4 feet 8 inches by 5 feet.
1,820	“ “	4 feet by 4 feet 4 inches.
1,803	“ “	3 feet 4 inches by 3 feet 8 inches.
1,561	“ “	3 feet by 3 feet 4 inches.
1,200	“ “	2 feet 6 inches by 3 feet.
605	“ “	2 feet 6 inches, barrel.
154	“ “	2 feet, barrel.
60	“ “	3 feet by 1 foot 6 inches, rectangular.
12	“ “	4 feet by 4 feet 4 inches, rectangular.

Total, 7,980 feet.

From the terminus of the brick sewer, the system is completed to the entrance arch of the driveway with Scotch drain-pipes, varying from 16 inches to 6 inches in diameter.

Where the sewer passes directly under the aqueduct, the excavation was in solid rock, requiring great care in blasting. The entire trench

was afterwards filled for 50 feet in length with concrete, built up to the height of the top of the invert of the aqueduct.

A considerable length of this sewer is from 15 to 20 feet below the natural surface, and a portion was built through solid rock.

THE 48-INCH MAIN.

From the effluent gate-house a 48-inch main is carried around Fisher hill to connect with the pipes which supply the city from Brookline reservoir, so that in case of any accident to that reservoir, the city can be supplied from Chestnut Hill.

The length of the 48-inch pipe is about one mile and a quarter. Its thickness is $1\frac{1}{4}$ inches. A blow-off was placed in a culvert near Beacon street, and there is an air-cock at the Goddard summit. There are four gates at the junction of this pipe with the other mains; three, a 40-inch, a 36-inch, and a 30-inch connection, are together in one underground chamber; and a 48-inch gate on the main itself, which was put in in April, 1875, is a little back and separated from the chamber.

Any one wishing to look more into the details of this reservoir is referred to the Annual Reports of the Water Board, and to City Documents Nos. 15, 27 and 73, of 1868; No. 59, of 1869, and No. 65, of 1870.

TABLETS.

The tablet in the effluent gate-house bears the following inscription:—

Chestnut Hill Reservoir,

Commenced April 2, 1866.

Completed Oct'r. 25, 1870.

Water area $123\frac{1}{2}$ acres; Capacity 731,473,000 gallons.

Cochituate Water Board for 1870.

Nathaniel J. Bradlee, President.

Walter E. Hawes

George Lewis

John O. Poor

Charles H. Allen

Hollis R. Gray

John A. Haven.

City Engineer, N. Henry Crafts.

Resident Engineer, Henry M. Wightman.

Superintendent, Albert Stanwood.

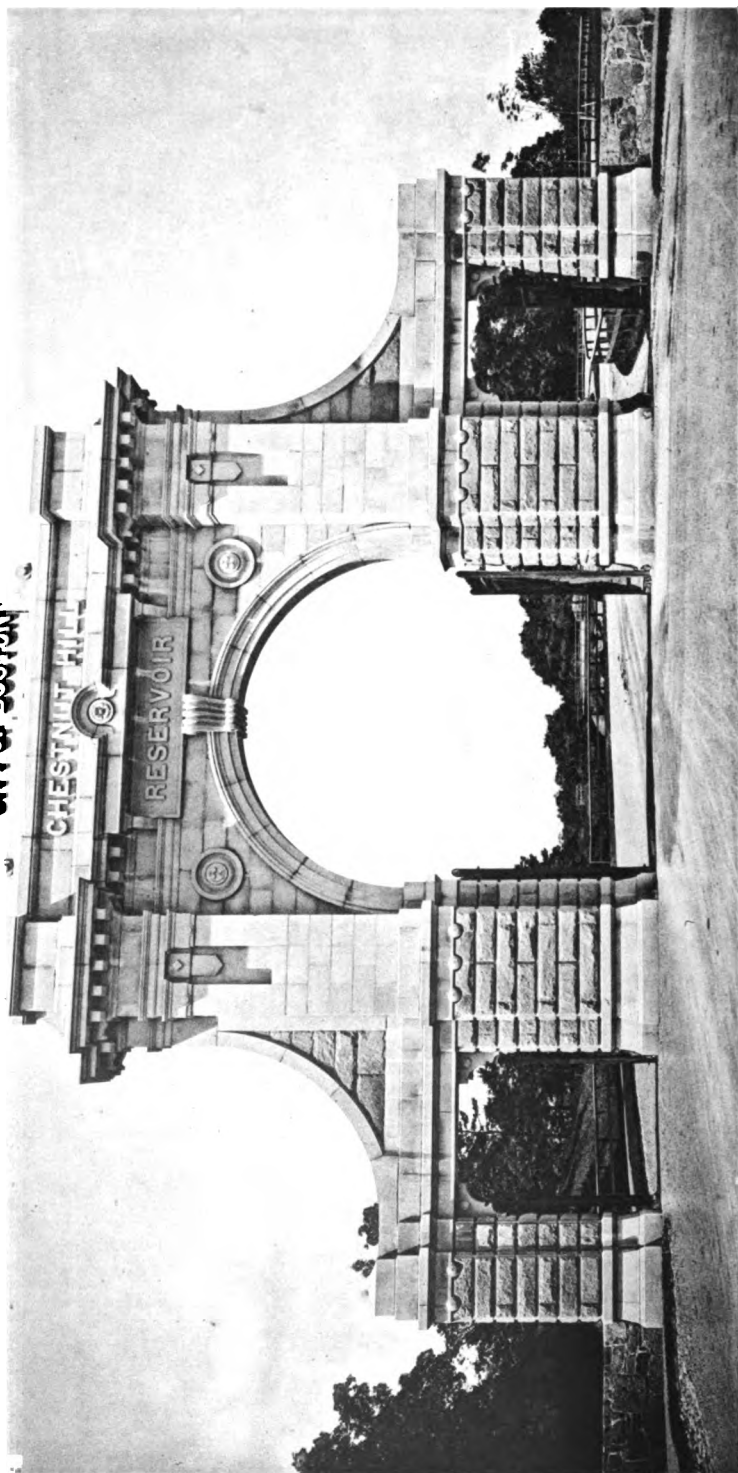
Mayors of Boston during its Construction.

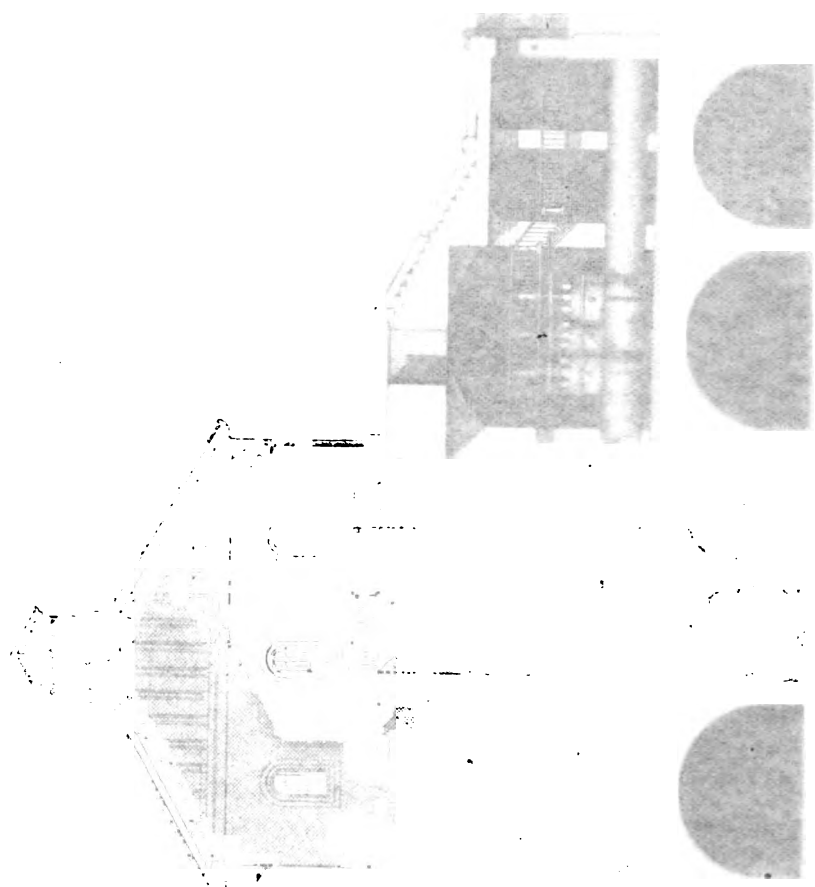
Frederic W. Lincoln Jr. 1866.

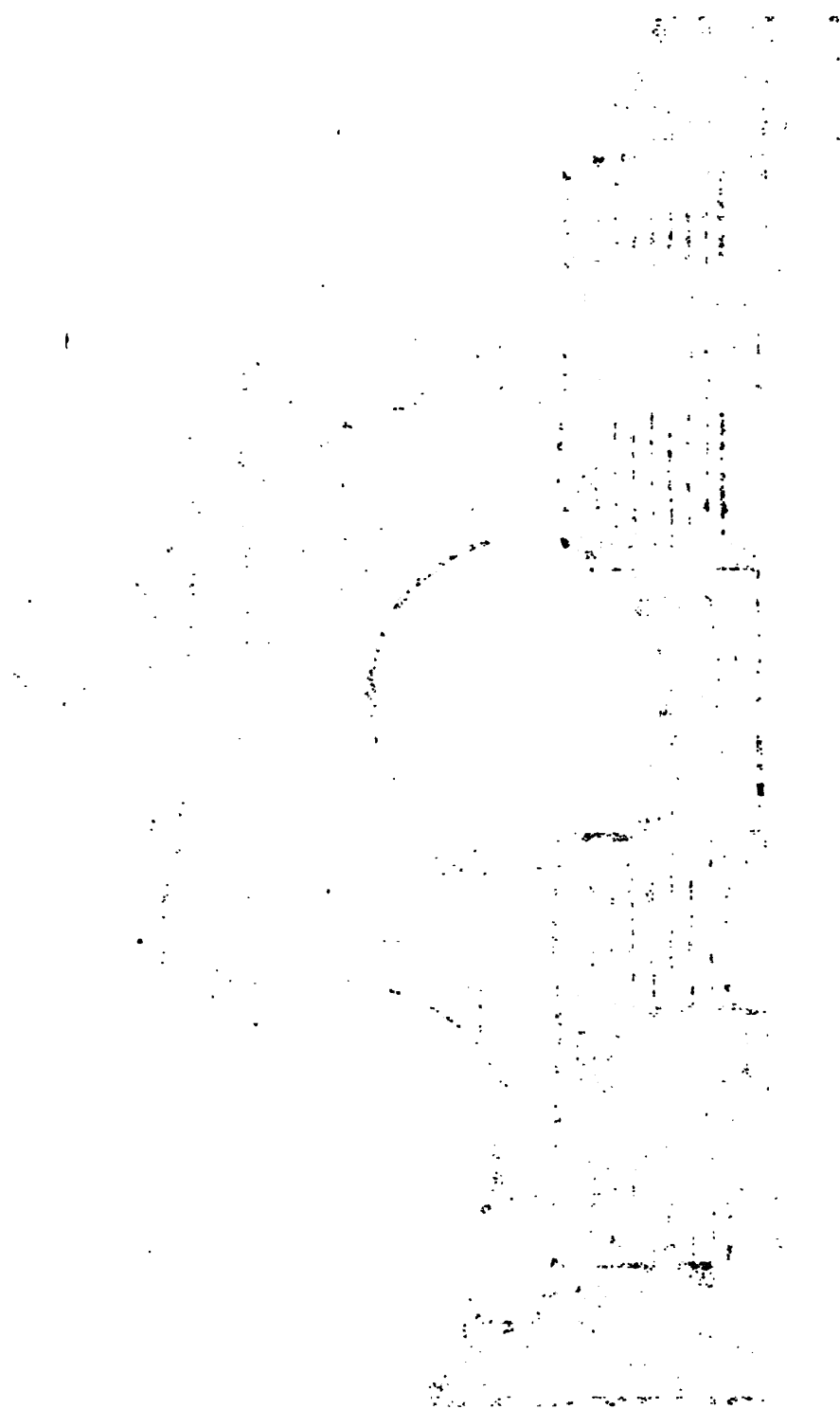
Otis Norcross 1867.

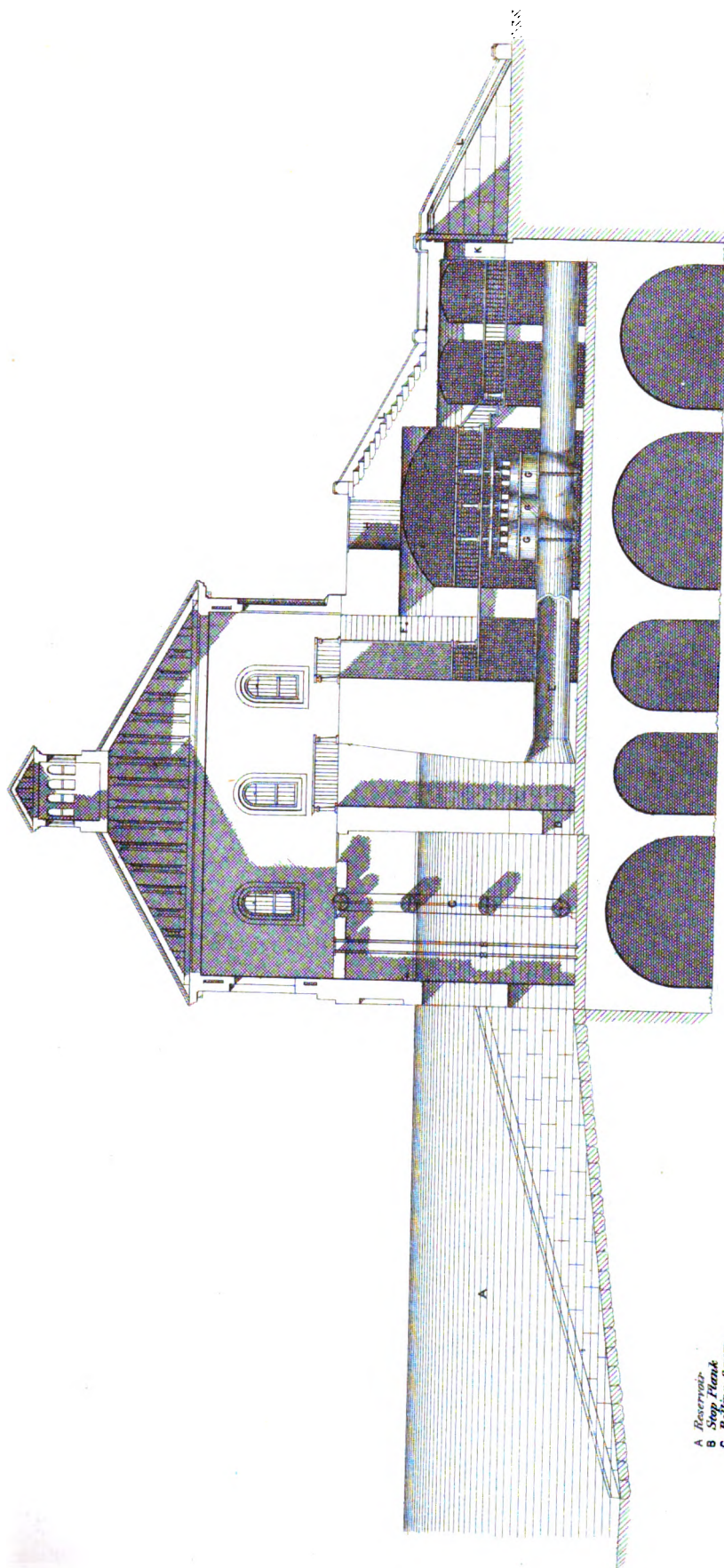
Nath'l B. Shurtleff 1868-69-70.


CITY OF CHESTNUT HILL



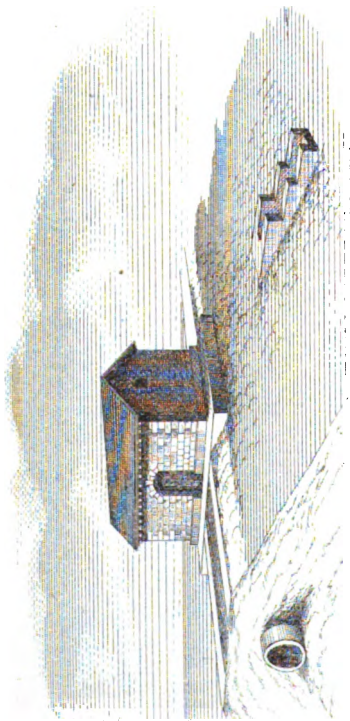




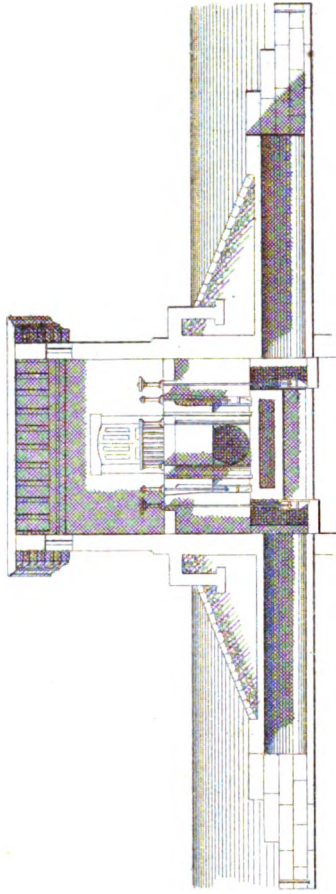


*Longitudinal Vertical Section
of
Lower Gate House
Chestnut Hill Reservoir.*

- A Reservoir
- B Stop Flange
- C Rolling Screen
- D Gate
- E 48 inch Pipe
- F Sluice down from Upper Floor
- G Stop Cock
- H Light to Pipe Chamber
- K Door under Reinforcement
- L Steps up to Gate House

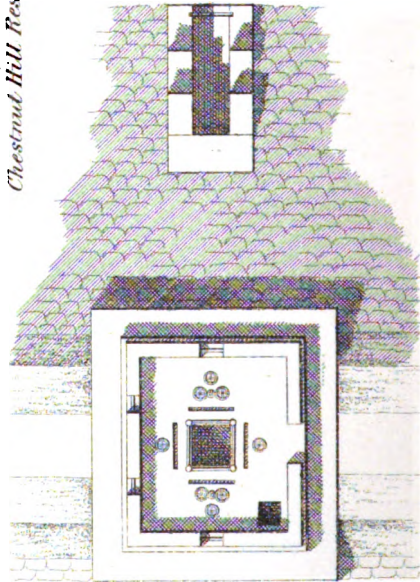


Perspective View.

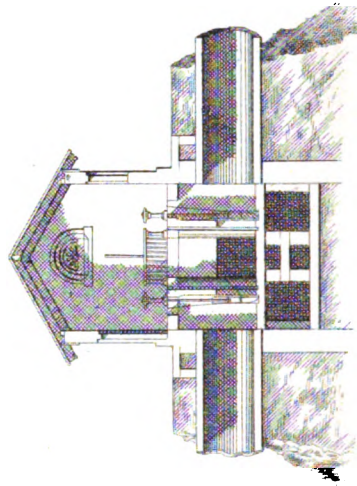


Longitudinal Vertical Section.

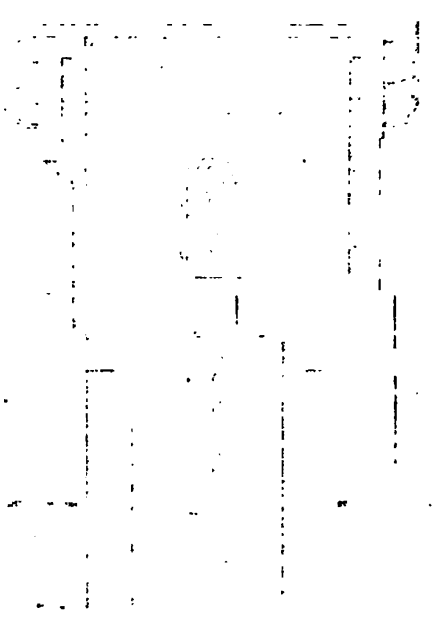
*Intermediate Gate House
at
Chestnut Hill Reservoir.*



Plan.



Vertical Transverse Section.



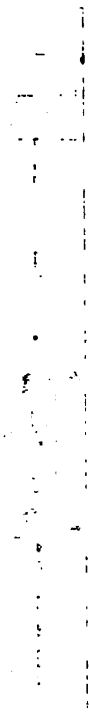
Architectural Detail

Technical Drawing

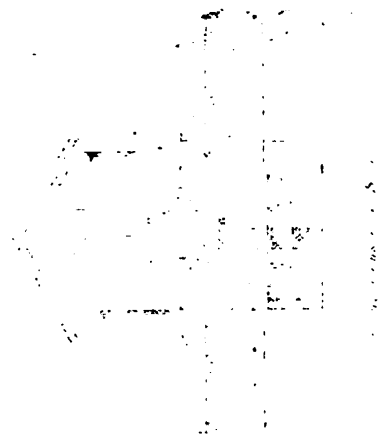
In the House

Chapel

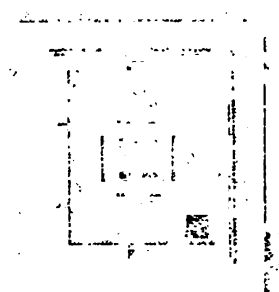
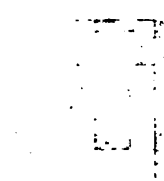
Parade Ground



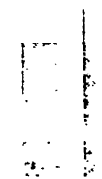
Front elevation to the S.W.

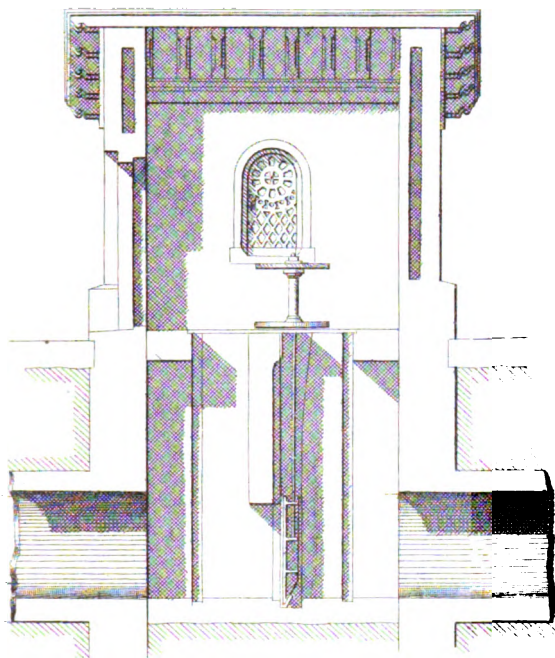


Side elevation to the S.W.
C. J. and J. H. Johnson

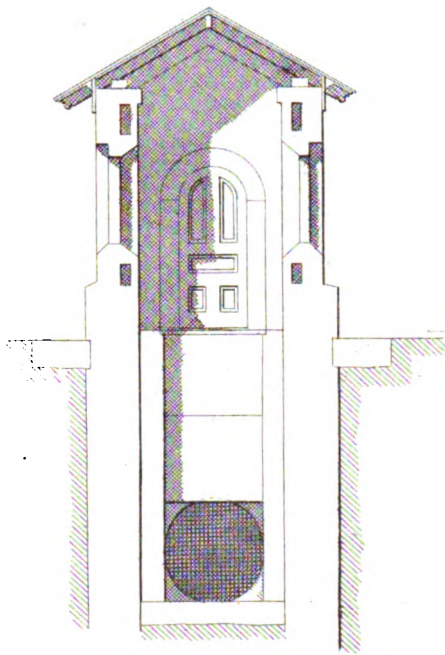


Side elevation to the S.W.



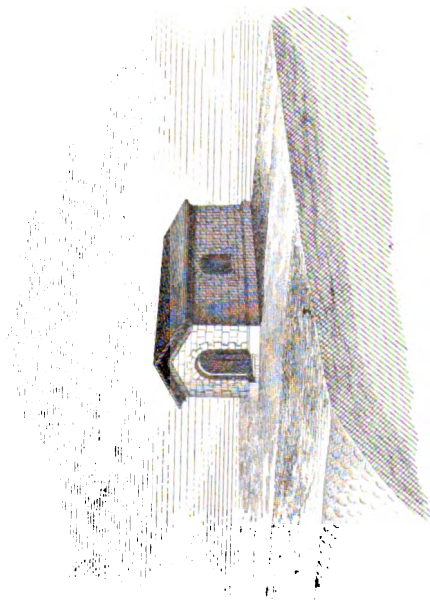


Longitudinal Vertical Section.

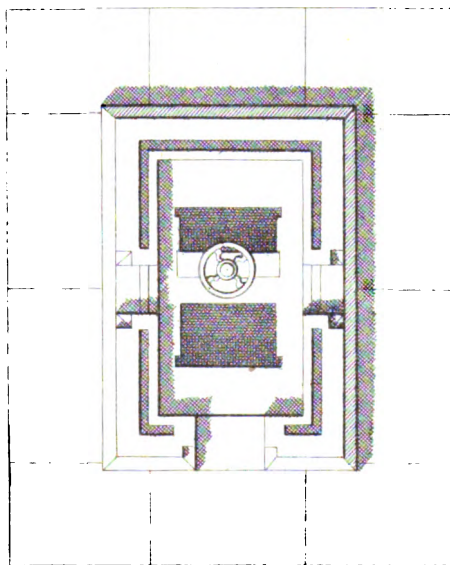


Vertical Transverse Section.

*Influent Gate House
at
Chestnut Hill Reservoir.*



Perspective View.



Plan

Presidents of the Board during its Construction.

Otis Norcross 1866.

John H. Thorndike 1867.

Nathaniel J. Bradlee 1868-69-70.

The following Inscriptions are on Tablets in the Intermediate Gate House : —

Chestnut Hill Reservoir.

1866. 1870.

Capacity of the Lawrence Basin 180,888,944 Gallons.

Capacity of the Bradlee Basin 550,583,485 Gallons.

Area of the Lawrence Basin $37\frac{268}{1000}$ Acres.Area of the Bradlee Basin $185\frac{363}{1000}$ Acres.

Greatest depth of water

In the Lawrence Basin, 17 feet.

In the Bradlee Basin, 32 feet.

Distance around the Basin

In the centre of the pathway

Lawrence Basin $1\frac{17}{100}$ miles.Bradlee Basin $1\frac{86}{100}$ miles.*Intermediate Gate-House.*

Commenced April 29, 1868.

Finished Oct. 24, 1868.

Water let into the Upper Basin

October 26, 1868.

Cochituate Water Board,

1868.

Nathaniel J. Bradlee, President.

Benjamin James

Alexander Wadsworth

Charles R. Train

Joseph M. Wightman

Benjamin F. Stevens

George Lewis.

Contractors.

Thomas J. Whidden	} For Mason Work
Joseph W. Coburn	

O. T. Rogers & Co. " Granite

S. S. Rowe " Slope Wall

Ricker & Wilson " Teams

DESCRIPTION OF THE CITY MAINS.

The City of Boston is supplied from its distributing reservoirs by means of three iron mains, 36 inches, 30 inches, and 40 inches in diameter. The two former lines of pipes were laid when the works were first built. The latter was laid in 1859. They all start from the effluent gate-house of the Brookline reservoir, situated in the town of Brookline.

The 40-inch main is connected with a 30-inch pipe, which was laid through the masonry bulkhead when the gate-house was built. It was not considered safe to remove it, but on top of the taper pipe forming the connection there is a 20-inch inlet which is now capped, and can be connected at any time through the bulkhead above the present pipe, should the supply be insufficient. Just outside of the gate-house each of these mains is supplied with a stopcock. After leaving the gate-house they pass into Boylston street, in an easterly direction, toward the city. The 30-inch is on the north side of the others; next to it comes the 36-inch; and then the 40-inch. A few hundred feet from the reservoir these mains are connected with a 48-inch pipe which leads from Chestnut-Hill reservoir.

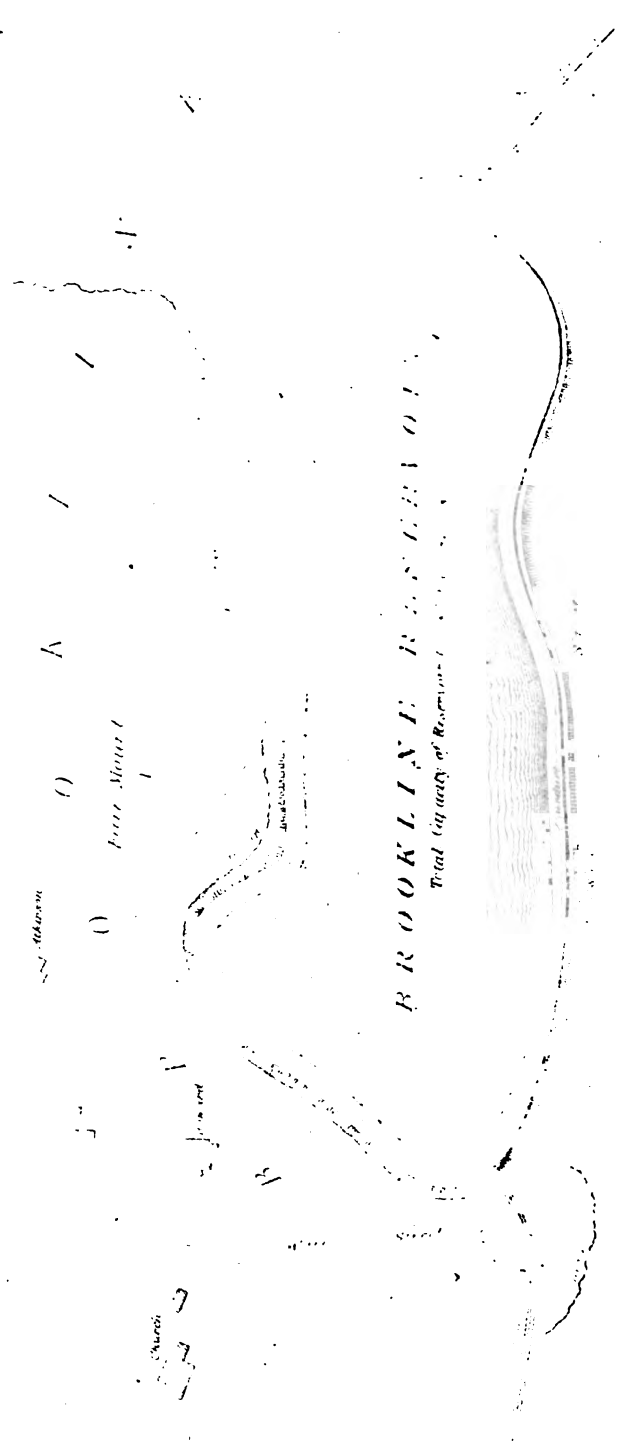
Three manhole covers, in Mrs. Goddard's field by the side of the road, give entrance to an underground chamber which contains three gates. Each of these gates connects the 48-inch main by means of a branch with one of the three principal mains, so that the supply from Chestnut Hill may be cut off or let on at pleasure from either of the mains.

Chestnut Hill being a very large reservoir, this connection prevents the head being drawn down in case of a sudden draught on the mains.

A 48-inch gate a little further back from the street allows of the water being shut off from all these mains by closing one gate. This gate, the largest one in the works, was added in 1874.

Between Brookline reservoir and these connections, there are three blow-offs into a brook, and on the 30-inch main there is a gate on the Boston side of the blow-off which will allow of Brookline reservoir being emptied without interfering with the supply from Chestnut-Hill reservoir. A few hundred feet further on, at the summit of Bradlee Hill, are three air-cocks.

The route of the mains is then through Boylston street, passing through Brookline village to the corner of Brookline avenue. Here the 40-inch main passes under the other two and continues by way of Brookline avenue and the Mill-Dam to the city. This route will be described separately.



BROOKLYN Total Capacity of Reservoir

NOTES

1. The dam is to be constructed of concrete and masonry. The foundation is to be excavated to a depth of 10 feet below the lowest water level. The dam is to be constructed in two sections, each 100 feet long. The first section is to be constructed first, and the second section is to be constructed after the first section is completed. The dam is to be constructed in accordance with the plans and specifications of the Engineer in Charge.

PLAN OF THE CITY MAINS.

1. The Chestnut-Hill reservoir, being supplied by a pipe from the city, has 30 inches and 40 inches in diameter. The pipes were laid when the works were first built. The main starts from the effluent gate-house and is directed in the town of Brookline.

The main is connected with a 30-inch pipe, which was the only bulkhead when the gate-house was built. It was found safe to remove it, but on top of the 30-inch pipe forming the bulkhead there is a 20-inch inlet which is now capped, and on the 30-inch pipe there is a 20-inch outlet above the trees by pipe, which is also insufficient. Just outside of the gate-house each of these pipes has a 20-inch approach. After leaving the gate-house the pipes run in the same direction, toward the city. The 30-inch pipe is on the left, and the 20-inch pipe is on the right. A few hundred feet from the reservoir, the main is connected with a 40-inch pipe which leads from Chestnut-Hill reservoir.

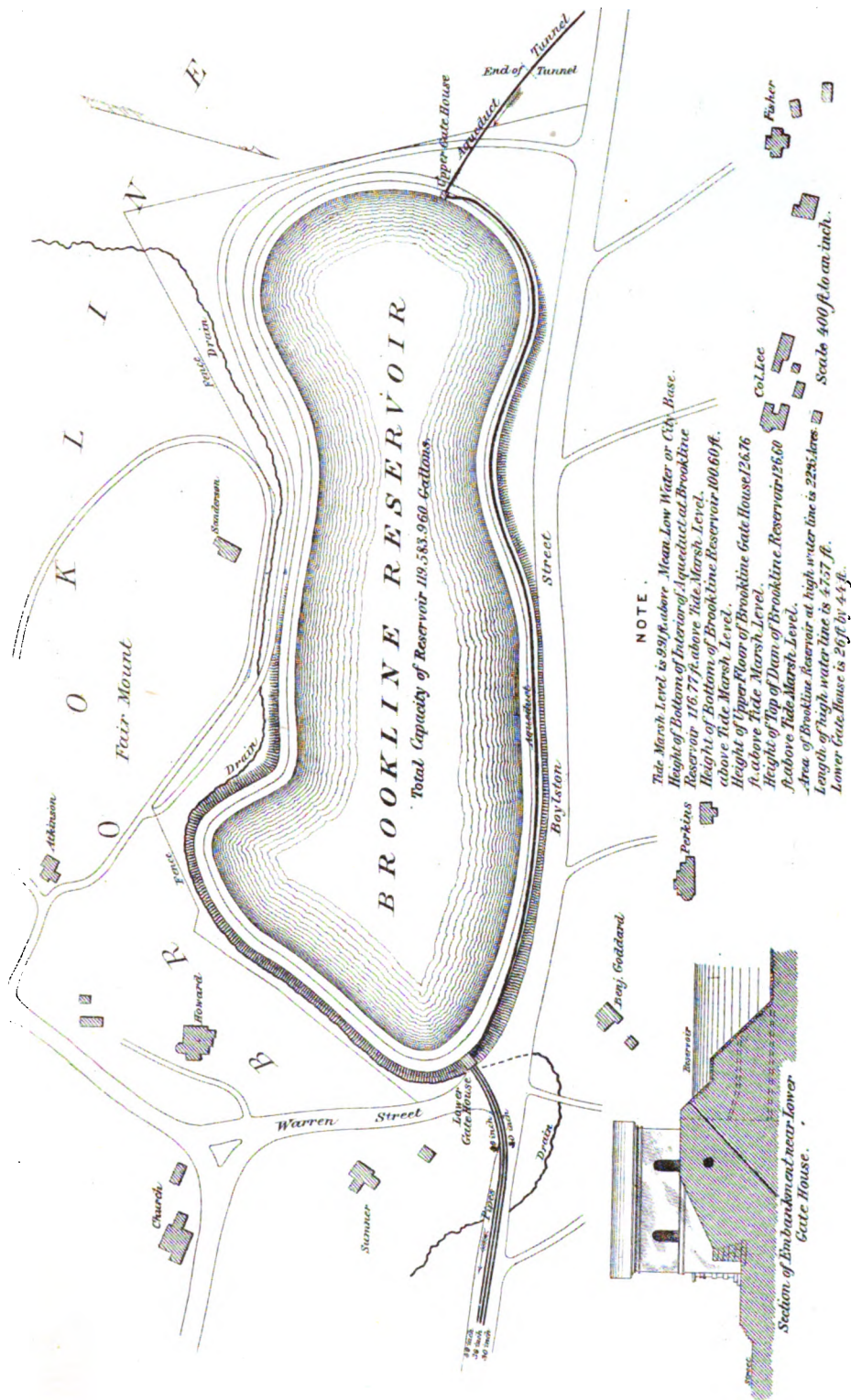
The main runs through Bradlee's field by the side of the road, and then enters a chamber which contains three gates. The main is 48 inches in diameter, and the 40-inch pipe is connected to it by means of a 40-inch elbow. The three pipes are 40 inches in diameter, so that the supply from Chestnut-Hill may be cut off, or the main may be cut off, or the pipes may be cut off.

Chestnut-Hill being a very large reservoir, it is connected to the main by a 40-inch pipe, which is 40 inches in diameter, and is 40 feet long.

A 48-inch pipe, which is 40 feet long, allows of the main being cut off, and the main is cut off by closing the gate. This gate is the largest one in the works, and was made in 1874.

Between Brookline reservoir and these connections, there are two blow-offs into a 40-inch pipe, and on the 30-inch main there is a gate cut off. The Boston side cut off, which will allow of Brookline reservoir being supplied with water, and the supply from Chestnut-Hill reservoir. A few hundred feet from the summit of Bradlee Hill, are the air-cocks.

The route of the main then through Boylston street, passing through Brookline village, and then through Brookline avenue. Here the 40-inch main passes under the 40-inch pipe, and continues by way of Brookline avenue and the Mill-Dam. This route will be described separately.



There are three gates and blow-offs on the mains at this point. They were put in in 1874.

The 36-inch and the 30-inch mains continue through Tremont street (which begins at the brook at these blow-offs) into the heart of the city. They cross under the Boston & Providence Railway near the Roxbury station.

Here branches off the 24-inch pipe for the supply of the Roxbury and Dorchester Districts, and the high service of the city, described more fully further on.

At Dover street, a distance of three miles and two-thirds from the reservoir, the 36-inch main is reduced to 30 inches. A 20-inch main is here taken off from the 36-inch for the supply of South Boston. There are two gates on the 36-inch at this point, one each side of the Dover street main.*

The two 30-inch mains then continue through Tremont street to Boylston street, crossing in their way the Boston & Albany Railroad by means of a plate-iron bridge.

From this point one of them, the original 30-inch, branches off into the Common towards Beacon Hill, and the other is joined by the 40-inch main which comes from the Mill-Dam across the Common.

A 30-inch branch from this pipe passes down Boylston street to Washington street, where it is reduced to 24 inches, and runs through Washington street, Dock square, Union, Merrimac, and Chardon streets to Bowdoin square, where it joins the 30-inch main from Beacon Hill.

At Haymarket square a 20-inch pipe is taken off from the 24-inch for the supply of East Boston.

THE 40-INCH MAIN,

already alluded to, after leaving the other mains at the corner of Brookline avenue and Boylston street, passes through Brookline avenue and Beacon street to Charles street, across Charles street and into the Common under the entrance-gate, and thence across the Common to a junction with the 30-inch main at the corner of Boylston and Tremont streets. This main is provided with blow-offs at the following places : —

- 1 near the gate-house on Boylston street.
- 2 at the Punch-Bowl corner, where it leaves the other mains, one each side of the gate.
- 2 at the Mill-Dam, corner of Brighton avenue, — 1 each side the gate.
- 1 at Exeter street, near the low-water gates, west side.

* The route of this South Boston main will be described under the head of South Boston.

1 at Charles street.

All are 16 inches in diameter except the last two.

"The work of laying this 40-inch main was commenced April 8th, 1859, and was completed May 8th, 1860, at an expense of \$304,991.83. The total number of pipes purchased for this main was 1,947, besides the branches and reducing pipes; and the total weight of metal 5,827 tons, which cost \$196,004.12."

In passing over the Mill-Dam this main is laid on the southerly side of the road.

In crossing the Common a connection is made opposite Mason street with the 30-inch main to Beacon Hill.

There is also in the Common a 12-inch connection from this main to the Frog pond.

At Longwood avenue there are two 12-inch connections for the supply of Longwood.

At the junction of Brighton avenue and the Mill-Dam there is a connection with a 12-inch pipe, which at present supplies Brighton.

At Exeter street a 16-inch pipe connects with the 40-inch, and there is also at this point a connection with the 12-inch pipe on Beacon street.

At Arlington street there is a connection with a 12-inch pipe running through Arlington street, and at Charles street a connection with a 16-inch pipe which runs through Charles street to Leverett street, where it is reduced to 12 inches, then continuing through Leverett street and Lynde street to a junction with the 30-inch Beacon-Hill main. In its passage through Leverett street this 12-inch pipe is connected with the 12-inch pipe which runs through Causeway and Commercial streets.

In passing through Tremont street the mains are situated in the following order:—

From the B. & P. R. R., crossing easterly as far as Northampton street, there is the 20-inch high-service main on the northerly side of the street. Next to it comes the 12-inch service pipe as far as Burke street, where it crosses to the southerly side of the street. Next comes the 30-inch, and then the 36-inch.

From the 36-inch nearly all of the distributing connections are made. The 30-inch main was used as a high-service pipe, after the introduction of the high service, until the 20-inch high-service main was laid in 1874; and before the introduction of the high service it was used to supply Beacon Hill, and consequently has few connections with the distribution system, and those only at important points.

The 36-inch main has the following connections in its passage through Tremont street : —

1. A gate and 2 blow-offs at the Brookline line.
2. A 12-inch connection at Heath street.
3. A 16-inch “ “ Terrace street.
4. A 24-inch “ “ Providence Railroad crossing.
5. Two 12-inch connections at Ruggles street.
6. A 12-inch connection at Northampton street.
7. A gate at West Chester Park street.
8. A 12-inch connection at West Newton street.
9. A 12-inch “ “ Waltham street.
10. A 20-inch “ “ Dover street. From here the 36-inch becomes a 30-inch pipe.
11. A 12-inch connection at Berkeley street.
12. A 12-inch “ “ West Castle street.
13. A 12-inch connection at Pleasant street.
14. A 16-inch “ “ Hollis street.
15. A connection with the 30 and 40 inch mains at Boylston street.

The 30-inch main has the following connections in passing the same distance : —

1. A gate and 2 blow-offs at the Brookline line.
2. A 24-inch connection at the Providence Railroad crossing.
3. A gate and a connection with a 12-inch pipe at the Providence Railroad crossing.
4. A gate at West Chester Park street.

After arriving at Boylston street, this main turns into the Common, with connections opposite Mason street with the 40-inch low-service main and the 16-inch high service, so that in case of any accident to the high-service main west of this point, the 30-inch can be used as a high-service pipe.

The 30-inch has also a 16-inch connection to the Frog pond and then continues to Beacon street, at the corner of Joy street, through Joy, Mt. Vernon and Hancock streets, to the reservoir on Beacon Hill; thence through Hancock street and Cambridge street to Bowdoin square, where a connection is made with the 24-inch Washington-street main.

From the 40-inch, at the junction of Boylston and Tremont streets, a 16-inch pipe runs northerly through Tremont street as far as School street, where it is reduced to 12 inches, and connects by means of a 12-inch pipe through Court street with the large main in Bowdoin square.

The 24-inch Washington-street main has the following connections : —

Two 20-inch connections at Haymarket square with the East Boston main; 16-inch connections at Milk, Hanover and Canal streets; and 12-inch connections at Bedford, Temple place, Summer, Franklin, School, Water, State, Court, Washington, Hanover and Merrimack streets.

The 20-inch East Boston main passes through Charlestown and Beverly streets to Warren bridge.

The 16-inch pipe at Milk street runs through Milk street, making various connections with the distributing system in that portion of the city.

The 16-inch pipe at Hanover street runs easterly down Hanover street, connecting with 12-inch pipes at Blackstone, Prince and Fleet streets.

From Fleet to Commercial the 16-inch is reduced to 12-inch.

The 16-inch Canal-street pipe runs through Canal street as far as Causeway street, joining the 12-inch pipe in that street which continues all the way around through Commercial street for the supply of the wharves. It has connections at various streets with other pipes.

A portion of Harrison avenue and Albany street have 12-inch pipes.

The Harrison-avenue pipe has connections on each side of the Dover-street 20-inch main with that pipe. It also connects at Waltham and Newton streets with 12-inch pipes.

Washington street, from Indiana place to Northampton street, has a 6-inch pipe.

BEACON-HILL HIGH SERVICE.

This district is supplied by a 20-inch main, which starts from the 24-inch main on New Heath street, opposite Pyncheon street. It runs through Pyncheon and Tremont streets to Northampton street, through Northampton street and Columbus avenue to Berkeley street, where it is reduced to 16 inches, thence continuing across the Common to Beacon Hill. The only connection this 20-inch main has in its whole length from New Heath street to Berkeley street is at Roxbury street, where a 12-inch pipe, which formerly fed the 30-inch, leads through Roxbury street a short distance to the 16-inch rising main at Gardner street, so that in case of any accident to the supply from Parker Hill, the pressure can be kept up from the stand-pipe. This high-service main was laid in the fall of 1874.

At Berkeley street the South Boston supply branches off, referred to under the head of South Boston High Service.

The Beacon-Hill District embraces, according to a report of Mr. Crafts, in 1870, 47.65 acres, including the streets, whose area is 16.51 acres.

The population he places at 6,000, and the dwelling-houses at 636, not including some 13 public buildings.

As this area was then entirely built over, the above figures are probably nearly correct for the present time. Before the new 20-inch main was laid, the supply was kept up through the 30-inch main, which had to be devoted exclusively to this purpose.

SOUTH BOSTON LOW SERVICE (PRINCIPALLY WARD 14).

The low service of South Boston is supplied by two 20-inch mains :—

The first leaves the 36-inch main at the junction of Tremont and Dover streets, passing through Dover street, crossing the Dover-street draw-bridge by means of an inverted siphon, then through East Fourth, West Fourth and Atlantic streets to the reservoir on Telegraph Hill. This main crosses in its route the Old Colony and the New York and New England Railways. This pipe was laid when the Cochituate Works were first built. "At the draw the pipe is carried down into a trench excavated in the hard bottom of the channel, a distance of $32\frac{1}{2}$ feet below the top of the bridge, and brought up on the opposite side, the siphon being laid in a box filled in with hydraulic cement. The distance between the arms of the siphon is 41 feet."

The second 20-inch main connects with the 24-inch main in Stoughton street, Dorchester, and passes through Boston, Dorchester and Telegraph streets to the reservoir on Telegraph Hill, crossing in its route the Old Colony R. R. This main has at present no connection except at the corner of Atlantic and Thomas streets, where it connects with the first 20-inch main from Dover street.

Nearly all of the streets in South Boston are piped with 6-inch pipes. A few of the principal streets have 12-inch pipes.

The reservoir, owing to its leaky condition, is not used at present in connection with the general circulation.

SOUTH BOSTON HIGH SERVICE.

At Berkeley street, in the city proper, a 12-inch pipe, connecting with the 20-inch high-service main, runs through Berkeley, Dover, Foundry, Swan, West Fifth, Old Harbor and Thomas streets to a connection with the high-service pipes opposite the reservoir. There is an inverted siphon on this line of pipes near the Dover-street draw. It consists of a strong box made of 12-inch by 14-inch hard-pine timber, well bolted together, and held by iron straps and knee timbers at the angles, where

the horizontal portion joins the vertical arms. In this box is laid a 16-inch pipe. The space between the box and the pipe is filled with concrete. The box is 48 feet in length. The vertical arms are $28\frac{1}{2}$ and $25\frac{3}{4}$ feet in height, and the grade of the bottom of the box is 17 feet below mean low water. This piece of work was built and lowered by Boynton Bros. & Freeman.

Until the fall of 1874, when the above main was laid, the high service of South Boston was supplied temporarily, during 1873, through the 12-inch high-service main in Washington street, Dorchester. The 20-inch low-service main, leading from Upham's Corner, in Dorchester, to Telegraph Hill, was made use of for this connection. The supply to the low service of South Boston during this time was kept up entirely through the old 20-inch main in Dover street.

EAST BOSTON (WARDS 1 AND 2).

East Boston derives its supply from a 20-inch main, which connects with the 24-inch main in Haymarket square of the city proper. The route of this 20-inch main is as follows: Through Charlestown and Beverly streets to Warren bridge; across Warren bridge, passing through Charlestown (now Wards 3, 4, and 5 of the City of Boston) by way of Warren avenue and Chelsea street to Chelsea bridge; thence across Chelsea bridge to the City of Chelsea; thence passing to Chelsea creek; thence across Chelsea creek to Brooks street in East Boston. After passing a short distance through Brooks street, it enters the reservoir. In passing over Warren bridge to Charlestown this main is carried under the draw of the bridge by means of an inverted siphon with a dip of 36 feet and a distance between the arms of 39 feet.

At Charlestown square there is a 16-inch connection with the Mystic Water Works. There is another connection with these works in Charlestown, and two more in Chelsea.

In passing over Chelsea bridge the main crosses two draws. At the southerly draw nearest Charlestown there is an inverted siphon with a dip of 29 feet, and a distance between the arms of 39 feet. At the northerly draw nearest Chelsea there is another inverted siphon with a dip of 42 feet 5 inches, and a distance between the arms of 50 feet; all three of these siphons are enclosed in wooden boxes.

"It is carried across the channel in a flexible jointed pipe of nearly double the ordinary thickness, with swivel joints. The flexible portion of the pipe is about 461 feet long, laid in a trench dredged to about 6 feet in depth, and covered with clay and gravel to protect it from anchors."

Chelsea creek at this point is about 1,600 feet wide, and about 25 feet deep in the channel at low water, where vessels of large size pass.

The following description of the joint is taken from Mr. Bradlee's history. The joint, which was a novel one at that day, has been superseded by others of more modern design:—

“The joint used in the flexible portion was adopted by Mr. William S. Whitwell, the engineer. It is a novel and ingenious flange joint, flexible only in a perpendicular plane, but so secure as not to need a wooden frame to accompany the pipe. The adaptation of this joint to the purpose, and its strength, are quite admirable. The distance between the joints is 31 feet 4 inches, and each section consists of three pieces of 20-inch pipe $1\frac{1}{2}$ inches thick, with flanges 2 inches thick, securely bolted together. These three pieces of pipe weigh together 3,300 pounds, and each joint weighs 3,800 pounds, the size of the pipe being considerably enlarged at the joint. The opposite sections of the joint meet on a perpendicular plane parallel with the portions of the pipe on each side of the joint, and move upon a leather packing, which is placed in a groove between the two flanges. One of the flanges is so much wider than the other as to have a cap-ring bolted to it, which encloses and holds the other, and thus constitutes the joint. The strength of this arrangement is obvious, and its tightness has been tested by trial under a pressure of 250 pounds to the square inch. The jointed pipe for half the width of the channel was prepared on a staging, and sunk after having been covered with a varnish to preserve it from the action of the brine. It was sunk by being supported from a framework and tackles above, while the floor beneath it was removed and it was then lowered down in the centre, the ends being retained above water for the purpose of connecting with the shore and the section which still remained to be sunk. The other section was prepared and sunk in like manner, and thus was the connection established.”

In August, 1870, a leak was discovered in this pipe. A diver reported “a crack in one of the straight flanged pipes, immediately under the bolts and close to the flange. The crack was 18 inches in length, extending partly around the pipe, and the opening was not more than a sixteenth of an inch in width. The water issued in a sharp stream and with great force, manifesting itself by ebullition at the surface.”

Early in 1871, a new main, 24 inches in diameter, was laid across Chelsea creek and connected at each end with the 20-inch main. The crack in the old pipe was also repaired with wedges and bands.

This new main was laid with a ball-and-socket joint, movable only in a vertical plane.

The distribution from the reservoir in East Boston takes place through a 16-inch pipe laid from the reservoir through Brooks street to Chelsea street.

This main has 12-inch connections at White, Bennington and Chelsea streets.

The 12-inch connection at White street runs westerly through White street to Meridian street.

A 12-inch pipe runs the whole length of Meridian street with a connection with the 20-inch supply main by means of a 12-inch pipe through Condor street.

The 12-inch connection at Bennington street runs westerly through Bennington street to Central square, connecting with the other 12-inch pipes in that square.

The 12-inch connection at Chelsea street runs through Chelsea street, on one side, southwesterly to Maverick square, and on the other, northeasterly to Saratoga street, then through Saratoga street, easterly, to Deer Island.

Besides these pipes there are 12-inch pipes in Border street throughout its whole length; in Sumner street from Border street to Cottage street; in Lewis street and Cottage street; in Marginal street from Lewis to Cottage, and in Maverick street from Maverick square southeasterly to the water.

The rest of the streets are piped almost wholly with 6-inch pipes.

DEER ISLAND.*

Deer island is supplied with water from the 12-inch pipe in Saratoga street, East Boston.

From the end of Saratoga street a 10-inch pipe continues across Breed's Island and Winthrop bridge to Main street, in the town of Winthrop. This 10-inch pipe continues through Main street to Shirley street, where it is reduced to 8-inch. The route then continues through Shirley street to Shirley Gut, at the southern extremity of the town, and across Shirley Gut to Deer Island, supplying the city institutions on that island. Across Shirley Gut there are two lines of 8-inch pipe, with flexible joints, so that, in case of accident to either line, the other can be used.

These pipes across Shirley Gut were laid by Mr. John F. Ward, C. E., of Jersey City, the patentee and proprietor of a ball-and-socket joint, successfully used in other parts of the country. The pipes were put together on the beach and hauled into place by means of a cable attached to a capstan windlass placed on the Deer-Island side.

The following is a statement of the length and sizes of the pipes used in supplying Deer Island : —

* An island in the harbor on which the city reformatory institutions are located.

2,052½	feet of 12-inch pipe.
9,310½	“ “ 10-inch “
11,870	“ “ 8-inch “ in Winthrop.
3,173	“ “ 8-inch “ on Deer Island.
603¾	“ “ 8-inch “ across Shirley Gut.
150½	“ “ 4-inch “ for blow-offs.

One 12-inch gate, one 10-inch gate, eight 8-inch gates, six 4-inch gates, three air-cocks and seven post hydrants.*

The original pipe across Winthrop bridge was laid under the bridge without boxing. Trouble was experienced from the pipe freezing, and in the fall of 1872 a new line of pipes was laid in a double box, and the old line allowed to remain for use in case of accident to the new pipe.

ROXBURY† LOW SERVICE.

The Roxbury low service is principally supplied from the 24-inch Dorchester main, which starts from the 30-inch and 36-inch mains on Tremont street, near the Boston and Providence Railway crossing. Its route is through Roxbury and Dudley streets to the Dorchester line. Two 12-inch connections are made with the main near the railway crossing. One branch of the southerly of these connections passes through Roxbury by the side of the 24-inch main; the other crosses the railway, passing up Tremont street in the direction of Brookline by the side of the 36-inch and 30-inch mains. The first-named branch has the following 12-inch connections:—

At Pynchon, Washington, Warren, Dearborn, Hampden and Magazine streets, and Blue Hill avenue; and it is connected with the 24-inch main again at Washington, Dearborn and Hampden streets.

The Pynchon-street branch passes southwesterly through Pynchon, crossing the iron bridge over the Boston and Providence Railway, through Centre street to the West Roxbury line, where it terminates.

A 12-inch branch from this pipe passes through Lamartine street to the West Roxbury line, supplying the low service to that district.

The Washington-street branch passes southerly through Washington street as far as St. James street, where it becomes a high-service pipe.

The northerly branch continues into the city proper.

The Warren-street branch is laid to a junction with the high-service pipes at the corner of Walnut avenue and Warren street.

* Some slight additions have been made since these were laid.

† What was formerly the “City of Roxbury” is now nearly in the centre of the territory comprised within the city of Boston limits.

The Dearborn-street branch passes northerly through Dearborn and Albany streets to the city proper.

The Hampden-street branch passes northerly through Hampden street to Northampton street in the city proper.

The Magazine-street branch passes northeasterly through Magazine street, and then southeasterly through Norfolk avenue to the Dorchester line, where it terminates near the New York and New England Railway.

The Blue-Hill avenue branch passes southerly through Blue-Hill avenue to Edgewood street, then through Edgewood street to Warren street.

The above branches are all 12-inch pipes.

The territory bordering on Tremont street takes its supply from the Tremont-street service main, with the exception of Ruggles street, which has a 12-inch pipe connecting with the 36-inch main. It runs as far as Washington street, connecting there with the 12-inch pipe in that street.

There is a 12-inch pipe running westerly from Tremont street through Ruggles street to Parker street, then northeasterly through Parker street a short distance to Greenleaf street.

Parker street also has a 12-inch pipe laid from its junction with Tremont street to Prentiss street.

At Longwood avenue it connects with a 12-inch pipe laid through Longwood avenue to a junction with the 40-inch main in Brookline avenue.

The Longwood part of the Highland District is supplied by a 12-inch pipe in Longwood avenue, connecting with the 40-inch main and laid to within a short distance of the Brookline branch of the Boston and Albany Railroad.

There is a 12-inch pipe laid from the junction of Tremont and Heath streets, through Heath street as far as Day street, and through Day street as far as Creighton street.

A 6-inch pipe continues around Heath street, from the corner of Day street, connecting with the district supplied from the 24-inch main.

ROXBURY HIGH SERVICE.

As the high-service works are at present mostly situated in the Roxbury District, a few words of general description may not be out of place.

The pumping-engines on Elmwood street take their supply through a 16-inch connection with the 24-inch main in Roxbury street. The

force main is a 16-inch pipe leading through Elmwood, Gardner and Centre streets, and Fort avenue, to the stand-pipe.

At the junction of Cedar and Centre streets a 24-inch pipe connects with this 16-inch rising main, and passes through Centre, New Heath and Parker streets, and then through Fisher avenue to the Parker-Hill reservoir.

At the junction of New Heath and Pynchon streets the 20-inch main, for the supply of the high service of Beacon Hill and South Boston, branches off.

At the junction of Parker and New Heath streets a 16-inch pipe branches off in a southwesterly direction through Parker and Centre streets for the supply of the West Roxbury high service.

From the stand-pipe a 16-inch pipe is laid through Beach-Glen avenue, and other streets described farther on, and from this pipe the supply for the Roxbury and Dorchester Districts is taken.

The high service of Roxbury embraces the districts formerly known as the "Fort District," "Tommy's Rock District," "Parker Hill District," and "Seaver Hill District," together with a number of streets adjacent thereto, which have been added from time to time. This territory is supplied by a 16-inch main, which leads from the stand-pipe, in a southerly direction, to Beach-Glen avenue; thence through said avenue to Highland street, across Highland street, and through Ellis, Thornton, Valentine, Washington and Townsend streets to Walnut avenue, where it ends. A 12-inch pipe extends through Washington street, to the north, as far as St. James street, and to the south as far as Eggleston square. At the terminus of the 16-inch main on Townsend street, a 12-inch pipe connects, running through Walnut avenue to the south as far as Seaver street, and to Warren street on the north. A 12-inch pipe laid through Munroe, Warren and Washington streets, carries the high service to the Dorchester line. The 12-inch pipe on Warren street is carried northward to a junction with the 12-inch pipe on Walnut avenue. These pipes distribute, by means of smaller connections, all the water used in the Roxbury high service.*

WEST ROXBURY (WARD 33).

Low Service. — The low service of West Roxbury is supplied by the 12-inch pipe in Lamartine street, which comes from the Roxbury District. This pipe is laid through Lamartine street, a small portion of Green,

* Thresholds above grade 80 are reckoned in the high service.

Starr and Keyes streets, to South street, where it terminates. A 12-inch branch from this pipe passes through New Boylston, Washington and Green streets to Lamartine street.

High Service. — The high service derives its supply from a 16-inch main, which connects with the 24-inch pipe from Parker-Hill reservoir on one side, and the pumps on the other, at the junction of Parker and New Heath streets. This pipe passes through Parker and Centre streets in a southwesterly direction to the corner of Pond street, near Jamaica pond. Here it is reduced to 12 inches, and passes through Centre, South, Walkhill, Washington, South, Centre and Spring streets to near the Dedham line.

DORCHESTER (WARD 24) LOW SERVICE.

Dorchester derives its supply for the low service from a 24-inch main, which connects with the 36-inch and the 30-inch mains in Tremont street, near the Roxbury station of the Boston and Providence Railway.

This 24-inch main runs through Roxbury street, Eliot square and Dudley street in the Roxbury District. In its passage through these streets it has four connections, referred to under the head of "Roxbury."

After passing through Dudley street its route is through Stoughton street, crossing the New York and New England Railway near the Stoughton-street station, then through Pleasant and Commercial streets to Dorchester avenue, its present terminus.

In passing through Stoughton street this main has the following connection : —

Between Brook and Howard avenues, a connection with a 12-inch service main.

At the corner of Hancock street a 16-inch branch leads to the corner of Columbia and Hancock streets, where it is reduced to two 12-inch pipes.

At Boston street the 20-inch main, leading to South Boston, branches off. This point is known as Upham's Corner.

The following are the principal pipes laid at present in the Dorchester District, not including the high service : —

Dorchester avenue has a 12-inch pipe its entire length to Neponset river. Its principal connections are at Commercial street with the 24-inch main, at Adams street a 12-inch connection, and at its lower end another connection with Adams street.

Adams street has a 12-inch pipe nearly its whole length, viz. : from a point opposite Meeting-house Hill to Centre street, from King street to Ashmout street, and from Minot street to Washington street.

Neponset avenue has a 12-inch pipe as far as Walnut street, which supplies Port Norfolk.

Commercial Point is supplied by a 12-inch pipe in Commercial street. This pipe has a connection with a 24-inch main at its terminus in Dorchester avenue.

Savin Hill is supplied by a 6-inch pipe.

DORCHESTER HIGH SERVICE.

The high service of Dorchester is taken from the 16-inch main leading from the stand-pipe in Roxbury; thence through 12-inch pipes in Warren and Munroe streets, entering the Dorchester District through a 12-inch pipe in Washington street.

It crosses the New York and New England Railway near the Mt. Bowdoin station, and continues as far as Welles avenue.

There is a 12-inch connection on Columbia street, and a 12-inch connection at Bowdoin and Harvard streets.

The 12-inch pipe in Bowdoin street continues through that street to a junction with the Hancock-street pipe, which connects at Upham's Corner with the 24-inch main.

BRIGHTON (WARD 22) LOW SERVICE.

At present the Brighton District is supplied by a 16-inch pipe, leading from St. Mary's street on Brighton avenue, to Union square in Brighton, and thence through North Beacon street to Everett street, where the size is reduced to 12 inches.

From Everett street the 12-inch pipe continues through North Beacon street to the Boston and Albany Railroad, its present terminus.

The 16-inch main connects at St. Mary's street with a 12-inch pipe, which had been laid, before the annexation of Brighton, from the 40-inch main at the corner of Brookline avenue to St. Mary's street. The main crosses the Boston and Albany Railroad in Brighton avenue, near the Cottage Farm station, by means of an iron bridge of two continuous plate girders, each $137\frac{1}{2}$ feet long. There are 12-inch branches at Harvard avenue, Cambridge and Market streets.

The Harvard-avenue branch extends on the south side to the Brookline line, and on the north to Cambridge street, then through Cambridge street to Beacon Park.

The Cambridge-street branch is laid westerly through Cambridge and Washington streets to Oak square, where it is reduced to 8 inches, and carried to the Newton line.

The Market-street branch passes northerly through Market street, across the Boston and Albany Railroad near the Brighton station, and continues to the junction of the Western avenue, its present terminus. Southerly, this branch passes through Market street as far as Hill street, where it is reduced to 8 inches in diameter, joining the 12-inch pipe on Washington street.

From the Washington-street pipe a branch is taken off at the corner of Foster street, passing through Foster street to a point about 1,500 feet beyond Mt. Vernon street.

A portion of the above piping here included in the low service will eventually be supplied from the high service.

BRIGHTON HIGH SERVICE.

For a description of the temporary works in course of construction for the immediate supply of a portion of Brighton, see p. 166.

PART FOURTH.

ACTS OF THE GENERAL COURT.

ORDINANCES OF THE CITY.

RULES AND REGULATIONS OF THE COCHIT-
UATE WATER BOARD.

An act for supplying the City of Boston with pure water was passed March 25th, 1845 (Stat. 1845, c. 220) containing the provision that the act should be void unless accepted by a majority of the legal voters of the city, in their respective wards, within sixty days from its passage. The act was rejected by a vote of 3,670 yeas to 3,999 nays. (Records of returns of votes from the several wards May 19th, 1845.)

COCHITUATE WATER ACT.

1846.

CHAPTER 167.

AN ACT

FOR SUPPLYING THE CITY OF BOSTON WITH PURE WATER.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:—

SECTION 1. The City of Boston is hereby authorized, by and through the agency of three Commissioners, to be appointed in the manner hereinafter provided, to take, hold and convey, to, into and through the said city, the water of Long Pond, so called, in the towns of Natick, Wayland and Framingham, and the waters which may flow into and from the same, and any other ponds and streams within the distance of four miles from said Long Pond, and any water rights connected therewith; and may also take and hold, by purchase or otherwise, any lands or real estate necessary for laying and maintaining aqueducts for conducting, discharging, disposing of, and distributing water, and for forming reservoirs; and may also take and hold any land on and around the margin of said Long Pond, not exceeding five rods in width, measuring from the verge of said pond when the same shall be raised to the level of eight feet above the floor of the flume, at the outlet thereof, and on and around the said other ponds and streams so far as may be necessary for the preservation and purity of the same, for the purpose of furnishing a supply of pure water for the said City of Boston.

City may obtain water from Long Pond in Natick.

May take and hold land, 10 Cush. 296.

The City of Boston shall, within sixty days from the time they shall take any lands or ponds or streams of water, for the purposes of this act, file, in the office of the Registry of Deeds for the county where they are situate, a description of the lands, ponds, or streams of water so taken, as certain as is required in a common conveyance of lands, and a statement of the purpose for which taken; which said description and statement shall be signed by the said Mayor.

Shall file description of land, etc.

SECTION 2. The said city may by and through the same agency, make and build one or more permanent aqueducts from any of the aforesaid water sources, to, into and through the said city, and secure and maintain the same by any works suitable therefor; may connect

May construct aqueducts, etc.

- the said water sources with each other; may erect and maintain dams to raise and retain the waters therein; may make and maintain reservoirs within and without the said city; may make and establish such public hydrants in such places as may from time to time be deemed proper, and prescribe the purposes for which they may be used, and may change or discontinue the same; may distribute the water throughout the city, and for this purpose may lay down pipes to any house or building in said city, the owner, or owners thereof, having notice and not objecting thereto; may regulate the use of the said water within and without the said city, and establish the prices or rents to be paid therefor. And the said city may, for the purposes aforesaid, carry and conduct any aqueducts, or other works by them to be made and constructed, over or under any water-course, or any street, turnpike-road, railroad, highway, or other way, in such manner as not to obstruct or impede travel thereon; and may enter upon, and dig up any such road, street, or way, for the purpose of laying down pipes beneath the surface thereof, and for maintaining and repairing the same; and, in general, may do any other acts and things necessary, or convenient and proper, for the purposes of this act.
- May distribute water throughout the city.**
- Dig up highways.**
- Commissioners to be appointed.** SECTION 3. Three Commissioners shall be appointed by the City Council, who shall, during their continuance in office, execute and perform, and superintend and direct the execution and performance of all the works, matters and things mentioned in the preceding sections which are not otherwise specially provided for in this act; they shall be subject to such ordinances, rules and regulations, in the execution of their said trust, as the City Council may, from time to time, ordain and establish, not inconsistent with the provisions of this act, and the laws of this Commonwealth. They shall respectively hold their said offices for the term of three years, next after their said appointment, unless the aqueducts and works aforesaid shall be sooner completed; but they, or either of them, after having had an opportunity to be heard in his or their defence, may be removed at any time by a concurrent vote of two-thirds of each branch of the City Council; and in case of a vacancy in the Board of Commissioners, by death, resignation or removal, such vacancy shall be filled by the appointment of another Commissioner, in manner aforesaid, who shall hold his said office for the residue of the said term of three years, with all the powers, and subject to all the restrictions aforesaid. A major part of said Commissioners shall be a quorum for the exercise of the powers, and the performance of the duties of the said office. They shall, once in every six months, and whenever required by the City Council, make and present, in writing, a particular report and statement of all their acts and proceedings, and of the condition and progress of the works aforesaid.
- Tenure of office.**
- Quorum.**
- Salaries of Commissioners.** SECT. 4. Before the appointment of the Commissioners aforesaid, the City Council shall establish and fix the salaries or compensation to be paid to the Commissioners for their services, and the said salaries of the said Commissioners, so established and fixed as aforesaid, shall not be reduced during their continuance, respectively, in said office.
- SECT. 5. Whenever the said office of Commissioners shall cease,

either by the expiration of the said term of three years from the original appointment, or by the completion of the aqueducts, and works mentioned in the preceding sections of this act, all the rights, powers and authority given to the City of Boston by this act, shall be exercised by the said city, subject to all the duties, liabilities and restrictions herein contained, in such manner and by such agents, officers and servants, as the City Council shall from time to time ordain, appoint and direct.

Their powers to be exercised by the city, after their office shall cease.

SECT. 6. The said City of Boston shall be liable to pay all damages that shall be sustained by any persons in their property by the taking of any land, water, or water rights, or by the constructing of any aqueducts, reservoirs, or other works for the purposes of this act.

City to pay all damage.

And if the owner of any land, water, or water rights, which shall be taken as aforesaid, or other person who shall sustain damage as aforesaid, shall not agree upon the damages to be paid therefor, he may apply by petition, for the assessment of his damages, at any time within three years from the taking of the said land, water, or water rights as aforesaid, and not afterwards, to the Court of Common Pleas in the county in which the same are situate; such petition may be filed in the clerk's office of said Court, in vacation or in term-time, and the clerk shall thereupon issue a summons to the City of Boston, returnable if issued in vacation, to the then next term of the said Court, and if in term-time, returnable on such day as the said Court shall order, to appear and answer to the said petition; the said summons shall be served fourteen days at least before the return day thereof, by leaving a copy thereof, and of the said petition, certified by the officer who shall serve the same, with the Mayor or clerk of the said city; and the said Court may, upon default or hearing of the said city, appoint three judicious and disinterested freeholders of this Commonwealth who shall, after reasonable notice to the parties, assess the damages, if any, which such petitioner may have sustained as aforesaid; and the award of the said freeholders, or of the major part of them, being returned into and accepted by the said Court, shall be final, and judgment shall be rendered, and execution issued thereon, for the prevailing party, with costs, unless one of the said parties shall claim a trial by jury as hereinafter provided.

8 Cush. 276.
10 Cush. 275.

Application to Court in case of disagreement.

Court may appoint three freeholders to assess damages.

SECT. 7. If either of the parties mentioned in the preceding section, shall be dissatisfied with the amount of damages awarded as therein expressed, such party may, at the term at which such award was accepted, or the next term thereafter, claim, in writing a trial in said Court, and have a jury to hear and determine at the bar of said Court all questions of fact relating to such damages, and to assess the amount thereof; and the verdict of such jury being accepted and recorded by the said Court, shall be final and conclusive, and judgment shall be rendered and execution issued thereon; and costs shall be recovered by the said parties respectively, in the same manner as is provided by law, in regard to proceedings relating to the laying out of highways.

Parties may claim trial by jury.

See G. S. c. 43.

SECT. 8. No application shall be made to the Court for the assess-

No application for damages for water until actual diversion.

* Now the Superior Court.

ment of damages for the taking of any water rights, until the water shall be actually withdrawn or diverted by the said city under the authority of this act; and any person or corporation whose water rights may be thus taken and affected, may make his application aforesaid, at any time within three years from the time when the waters shall be first actually withdrawn or diverted as aforesaid.*

City Council may
issue water-scrip, to
defray expenses.

SECT. 9. For the purpose of defraying all the costs and expenses of such lands, estates, waters and water rights, as shall be taken, purchased or held for the purposes mentioned in this act, and of constructing all aqueducts and works necessary and proper for the accomplishment of the said purposes, and all expenses incident thereto, the City Council shall have authority to issue, from time to time, notes, scrip, or certificates of debt, to be denominated on the face thereof, "Boston Water Scrip," to an amount not exceeding in the whole, the sum of three millions of dollars, bearing interest at a rate not exceeding the legal rate of interest in this Commonwealth; and said interest shall be payable semi-annually, and the principal shall be payable at periods not more than forty years from the issuing of the said scrip, notes or certificates respectively. And the said City Council may sell the same, or any part thereof from time to time, at public or private sale, or pledge the same for money borrowed for the purposes aforesaid, on such terms and conditions as the said City Council shall judge proper.†

And interest.

SECT. 10. In addition to the sum of three millions of dollars mentioned in the preceding section, the said City Council may, whenever and so far as may be necessary, issue and dispose of notes, scrip, or certificates of debt, in the manner prescribed in the preceding section, to meet all payments of interest which may accrue upon any scrip by them issued: *Provided, however*, that no scrip shall be issued for the payment of interest as aforesaid, after the expiration of two years from the completion of said aqueducts and other works; but payment of all interest that shall accrue after that time, shall be made from the net income, rents, and receipts for the use of the water, if they shall be sufficient for that purpose, and if not, then the payment of the deficiency shall be otherwise provided for by the City Council. All notes, scrip, and certificates of debt to be issued as aforesaid, shall be signed by the Treasurer, and Auditor, and countersigned by the Mayor of the said city, and a record of all such notes, scrip, and certificates shall be made and kept by the said Treasurer and Auditor respectively.

But not after two
years from comple-
tion of aqueduct, etc.

Form of scrip.

City Council to regu-
late the price of
water.

SECT. 11. The City Council shall, from time to time, regulate the price or rents for the use of the water, with a view to the payment, from the net income, rents and receipts therefor, not only of the semi-annual interest, but ultimately of the principal also of the "Boston Water Scrip," so far as the same may be practicable and reasonable.

Net surplus income
to be applied to pay-
ment of principal
and interest of scrip.

And the said net surplus income, rents and receipts, after deducting all expenses and charges of distribution, shall be set apart as a Sinking Fund, and shall be appropriated for and towards the payment of the

* See Sec. 2, chap. 187, 1849, p. 200, and chap. 316, 1850, p. 202.

† See chap. 33, 1848, p. 199, and Sec. 1, chap. 187, 1849, p. 200.

principal and interest of the said scrip; and shall, under the management, control, and direction of the Mayor, Treasurer, and Auditor of the city, or the major part of them for the time being, who shall be trustees of the said fund, be applied solely to the use and purpose aforesaid, until the said scrip shall be fully paid and discharged. And the said trustees shall, whenever thereto required by the City Council, render a just, true and full account to the said City Council of all their receipts, payments, and doings, under the provisions of this section.

SECT. 12. At any time after the expiration of two years from the completion of the works mentioned in the second section of this act, and before the reimbursement of the principal of the "Boston Water Scrip" hereinbefore mentioned, if the surplus income and receipts for the use of the water distributed under the provisions of this act, at the price established by the City Council, after deducting all expenses and charges of distribution, shall, for any two successive years, be insufficient to pay the accruing interest on the said scrip, then the Supreme Judicial Court, on the petition of one hundred or more of the legal voters of the said city, praying that the said price may be raised and increased so far as may be necessary for the purpose of paying, from the said surplus income and receipts, the said accruing interest, and upon due notice of the pendency of such petition given to the said city in such manner as the said Court shall order, may appoint three Commissioners, who, upon due notice to the parties interested, may raise and increase the said price, if they shall judge proper, so far as may be necessary, in their judgment, for the purpose aforesaid, and no further. And the award of said Commissioners, or the major part of them, being returned to the said Court, at the then next term thereof, for the county of Suffolk, and accepted by the said Court, shall be binding and conclusive, for the term of three years next after the said acceptance, and until the price so fixed by the Commissioners shall, after the expiration of said term, be changed or altered by the City Council.

See city docs. for
1848, No. 46.
1850, No. 18.
1852, No. 24.
1863, No. 47.

If surplus income is
insufficient to pay
the interest, the
Supreme Judicial
Court may, on peti-
tion, etc., appoint
Commissioners who
may raise the price
of water.

SECT. 13. If the surplus income and receipts for the use of the water distributed under the provisions of this act, at the price established by the City Council, after deducting all expenses and charges of distribution, shall, for any two successive years, be more than sufficient to pay the accruing interest on the "Boston Water Scrip," hereinbefore mentioned, then the Supreme Judicial Court, on the petition of one hundred or more of the legal voters of the said city, who may deem the said price unreasonably high, and pray for a reduction thereof, and upon due notice of the pendency of said petition given to the said city in such manner as the said Court shall order, may appoint three Commissioners, who, upon due notice to the parties interested, may, if they shall judge proper, reduce the price established by the City Council, *provided*, that such reduction shall not be so great that the surplus income and receipts aforesaid will, in the judgment of the said Commissioners, be thereafter insufficient for the payment of the said accruing interest. And the award of the said Commissioners, or the major part of them, being returned and accepted as mentioned in the

Or price of water
may be reduced.

Said reduction shall
not be so great that
such income will be
insufficient, etc.

Costs on such petitions.	<p>preceding section, shall be binding and conclusive, in the same manner, and to the same extent, as therein provided in regard to awards made pursuant to the provisions of that section.</p> <p>And the said Court may, at their discretion, order the costs on such petitions as are mentioned in this and the preceding section, and of the proceedings thereon, or any part thereof, to be paid by either of the said parties, and may enter judgment and issue execution therefor accordingly.</p>
Occupant of tenement and owner both liable for price of water. Action for unlawful use of water.	<p>SECT. 14. The occupant of any tenement shall be liable for the payment of the price or rent for the use of the water in such tenement; and the owner thereof shall be also liable if, on being notified of such use, he does not object thereto; and if any person or persons shall use any of the said water, either within or without the city, without the consent of the city, an action of trespass on the case may be maintained against him or them, by the said city, for the recovery of damages therefor; <i>provided, however</i>, that this act shall not be so construed as to prevent the inhabitants of Natick, Framingham, Sherburne and Wayland, from using so much of the water hereby granted as shall be necessary for extinguishing fires, and for all ordinary household purposes, under such regulations of the said City Council as may be essential for the preservation of the purity of the same.</p>
Certain towns may use water.	
Penalty for diverting or corrupting water.	<p>SECT. 15. If any person or persons shall wantonly or maliciously divert the water, or any part thereof, of any of the ponds, streams or water sources which shall be taken by the city pursuant to the provisions of this act, or shall corrupt the same, or render it impure, or destroy or injure any dam, aqueduct, pipe, conduit, hydrant, machinery, or other property held, owned or used by the said city by the authority and for the purposes of this act, every such person or persons shall forfeit and pay to the said city three times the amount of the damages that shall be assessed therefor, to be recovered by any proper action. And every such person or persons may moreover, on indictment and conviction of either of the wanton and malicious acts aforesaid, be punished by fine, not exceeding one thousand dollars, and imprisonment not exceeding one year.†</p>
1861, c. 220.	
City may purchase aqueduct corporation.*	<p>SECT. 16. The said City of Boston is hereby authorized to purchase and hold all the property, estates, rights and privileges of the Aqueduct Corporation incorporated by an act passed February twenty-seventh, in the year one thousand seven hundred and ninety-five, and by any convenient mode may connect the same with their other works.</p>
Act to be accepted by legal voters.	<p>SECT. 17. The Mayor and Aldermen of the City of Boston shall notify and warn the legal voters of the said city to meet in their respective wards on such day as the said Mayor and Aldermen shall direct, not exceeding thirty days from and after the passing of this act, for the purpose of giving their written votes upon the question, whether they will accept the same; and if a majority of the votes so</p>

* For acts respecting the Aqueduct Corporation, which was purchased by the City of Boston, June 10, 1851, see Stat. 1794, chap. 55; 1796, chap. 1; 1803, chap. 35. See also City Doc. 1851, No. 46.

† Increased to 10 years. See p. 205.

given upon the question aforesaid shall be in the negative, this act shall be null and void.*

SECT. 18. This act shall take effect from and after its passage,

HOUSE OF REPRESENTATIVES, March 30, 1846.

Passed to be enacted.

SAMUEL H. WALLEY, JR., *Speaker*.

IN SENATE, March 30, 1846.

Passed to be enacted.

W. B. CALHOUN, *President*.

March 30, 1876.

Approved.

GEORGE N. BRIGGS.

TEMPORARY LOAN ACT.

1848.

CHAPTER 33.

AN ACT

IN ADDITION TO "AN ACT FOR SUPPLYING THE CITY OF BOSTON WITH PURE WATER."

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows:—

Nothing in the ninth section of the Act, to which this is in addition, shall be construed to prohibit the City Council of the City of Boston, from making temporary loans for the purposes therein set forth, to be redeemed within five years by the "Boston Water Scrip:" provided, that the amount of said scrip shall in no case exceed the amount named in the said section.†

HOUSE OF REPRESENTATIVES, February 28th, 1848.

Passed to be enacted.

FRANCIS B. CROWNINSHIELD, *Speaker*.

IN SENATE, February 29, 1848.

Passed to be enacted.

ZENO SCUDDER, *President*.

February 29th, 1848.

Approved.

GEO. N. BRIGGS.

* This act was accepted April 13th, 1846, by a vote of 4,637 yeas to 348 nays. (Records of returns of votes from the several wards, April 13th, 1846.)

† See p. 196.

**ACT PROVIDING FOR FURTHER LOANS, FOR
METHODS OF PROCEEDINGS IN CASES OF DAM-
AGES SUSTAINED, AND FOR AUTHORITY TO
CONVEY WATER TO EAST BOSTON.**

1849.

CHAPTER 187.

AN ACT

**IN ADDITION TO "AN ACT FOR SUPPLYING THE CITY OF BOSTON WITH
PURE WATER."**

*Be it enacted by the Senate and House of Representatives, in General Court
assembled, and by the authority of the same, as follows:—*

\$1,500,000 additional
scrip authorized.

SECTION 1. In addition to the notes, scrip, or certificates of debt, authorized to be issued by the ninth section of the Act entitled "An Act for supplying the City of Boston with pure water," passed on the thirtieth day of March, in the year one thousand eight hundred and forty-six, being chapter one hundred and sixty-seven of the acts of that year, the City Council of the City of Boston are hereby authorized to issue, from time to time, notes, scrip, or certificates of debt, to be denominated, on the face thereof, "Boston Water Scrip," to an amount not exceeding, in the whole, the further sum of one million five hundred thousand dollars, for the same purposes, and in the same manner, and upon the terms and conditions specified in said section.

Proceedings in
cases of damages
sustained.

SECT. 2. Whenever any damages shall have been sustained by any persons in their property, by the taking of any land, water, or water rights, or by the constructing of any aqueducts, reservoirs, or other works, for the purposes of this act, and of the act to which this is in addition, and such persons shall neglect to institute proceedings against the City of Boston, according to the provisions of the said act, for the space of five months, it shall be lawful for the City of Boston to commence such proceedings, which shall go on, and be determined, in the same manner as if commenced by the persons who shall have sustained such damage; and, if such persons, on receiving due notice shall not come in and prosecute the proceedings so instituted, judgment shall be entered against them, and they shall be forever barred from recovering any damages under said act.

Water may be con-
veyed to East Bos-
ton through Charles-
town and Chelsea.

SECT. 3. The City of Boston is hereby authorized to convey the water of Long Pond to, into, and through, that part of Boston called East Boston, by laying their aqueduct, or water pipes, through the city of Charlestown and town of Chelsea; and, for that purpose, may have all the rights and privileges, and shall be subject to all the liabilities, mentioned in the act to which this is in addition.

Tide water struc-
tures.

And the said City of Boston may make any suitable structures for the purpose of conveying the said water over or under the tide waters within the jurisdiction of this Commonwealth, provided that such struc-

tures shall be approved of by a Commissioner, to be appointed for that purpose by the Governor and Council, and to be compensated by the City of Boston; provided, further, that the authority granted by this section shall not be exercised without the consent of the City Council of said city first had and obtained.

SECT. 4. This act shall not take effect unless accepted by the City Council of the City of Boston.*

HOUSE OF REPRESENTATIVES, April 30, 1849.

Passed to be enacted.

FRANCIS B. CROWNINSHIELD, *Speaker*.

IN SENATE, May 1st, 1849.

Passed to be enacted.

JOSEPH BELL, *President*.

May 1, 1849.

Approved.

GEO. N. BRIGGS.

EASTERN RAILROAD ACT.

1849.

CHAPTER 201.

AN ACT

AUTHORIZING THE EASTERN RAILROAD COMPANY TO EXTEND THEIR ROAD.

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows:—

SECTION 7. It shall be lawful for the City of Boston, under the direction of the Commissioner aforesaid, to lay and construct their water-pipes under, or by the side of said bridges, for the purpose of conveying water into and through East Boston, without compensation to the said railroad corporation; *provided, however*, that said pipes shall be so laid, maintained and repaired as not to retard, or in any manner obstruct, the regular and convenient use of said bridges, for all the uses of said railroad company.

* Accepted by the City Council, May 28, 1849. City Records, vol. 27, p. 239.

ACT IN RELATION TO DAMAGES BEFORE COURT OF COMMON PLEAS.**1850.****CHAPTER 316.****AN ACT****IN ADDITION TO AN ACT FOR SUPPLYING THE CITY OF BOSTON WITH PURE WATER.**

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows:—

SECTION 1. In every case of a petition to the Court of Common Pleas by any person, for the assessment of damages, as provided in the sixth, seventh and eighth sections of the act to which this is in addition, the City of Boston, by any of its officers, may tender to the complainant, or his attorney, any sum that it shall think proper, or may bring the same into Court, to be paid to the complainant for the damages claimed in his petition; and if the complainant shall not accept the same, with his costs up to that time, but shall proceed in the suit, he shall be entitled to his costs up to the time of the tender, or such payment into Court, and not afterwards, and the said city shall be entitled to recover its costs afterwards, unless the complainant shall recover greater damages than were so offered.*

SECT. 2. This act shall take effect from and after its passage.

HOUSE OF REPRESENTATIVES, May 3, 1850.

Passed to be enacted.

ENSIGN H. KELLOGG, *Speaker*.

IN SENATE, May 3, 1850.

Passed to be enacted.

MARSHALL P. WILDER, *President*.

May 3, 1850.

Approved.

GEO. N. BRIGGS.

* See pages 195 and 196.

ACT RESTRICTING CONTROL OVER TIDE WATERS.**1851.***CHAPTER 121.***AN ACT**

IN FURTHER ADDITION TO AN ACT FOR SUPPLYING THE CITY OF
BOSTON WITH PURE WATER.

*Be it enacted by the Senate and House of Representatives, in General
Court assembled, and by the authority of the same, as follows:—*

The control granted to the City of Boston over tide waters within the jurisdiction of this Commonwealth, by the third section of an act in addition to an act for supplying the City of Boston with pure water, passed on the first day of May, in the year one thousand eight hundred and forty-nine, shall be restricted to the line now occupied by them for the purpose specified in the said third section.

HOUSE OF REPRESENTATIVES, May 2, 1851.

Passed to be enacted.

N. P. BANKS, JR., *Speaker.*

IN SENATE, May 7, 1851,

Passed to be enacted.

HENRY WILSON, *President.*

May 7, 1851.

Approved.

GEO. S. BOUTWELL.

ACT TO RAISE LAKE COCHITUATE.**1850.***CHAPTER 184.***AN ACT**

TO AUTHORIZE THE CITY OF BOSTON TO RAISE THE DAM AT THE
OUTLET OF LAKE COCHITUATE.

SECTION 1. The City of Boston is hereby authorized, by and through the agency of the Cochituate Water Board therein, or by and through any other agency which shall be established therefor by the City Council of said city, to raise the dam at the outlet of Lake Cochituate, formerly called "Long Pond"; lying in the towns of Natick, Way-

City may raise dam
to ten feet above
Knight's flume.

Take real estate.	land, and Framingham, to the height of ten feet above the floor of "Knight's Flume," so-called; and may also take and hold, from time to time, by purchase or otherwise, any lands or real estate on and around the margin of said lake, not exceeding five rods in width, measuring from the verge of said lake, when the same shall be raised to the level authorized by this act, so far as such lands and real estate may be necessary for the preservation and purity of said lake, for the purpose of furnishing a supply of pure water for said City of Boston; <i>provided, however,</i> that no lands or real estate taken or purchased under this act shall be exempted from taxation, by reason of such taking or purchase. All lands and real estate within said towns, heretofore taken or purchased, and now held by said city, by virtue of an act approved March thirtieth, eighteen hundred and forty-six, or by virtue of any other act heretofore passed, shall be and remain exempted from taxation so long as they continue to be so held and used for the purpose of said acts.
Former lands exempt from taxation. 4 Gray, 500.	
City liable for damage.	SECT. 2. The said City of Boston shall be liable to pay all damages that shall be sustained by any persons in their property, by the taking of any land or real estate, or by the flowage of the lands of any person as aforesaid; and in regard to such taking and flowing, and the ascertainment and payment of all such damages, the said City of Boston, and all persons claiming damages, shall have all the rights, immunities, and remedies, and be subject to all the duties, liabilities and obligations, which are provided in the one hundred and sixty-seventh chapter of the acts of the year one thousand eight hundred and forty-six, the one hundred and eighty-seventh chapter of the acts of the year one thousand eight hundred and forty-nine, and the three hundred and sixteenth chapter of the acts of the year one thousand eight hundred and fifty. Said City of Boston shall also indemnify said towns of Natick and Wayland against all injury which may at any time be done to any highway or bridge in such towns, by reason of the raising of the water, and maintaining the dam, as hereinbefore provided.
Subject to acts of 1849 and 1850.	
Indemnify towns.	
Act not to take effect until money paid to towns.	SECT. 3. This act shall not take effect until said City of Boston shall have paid to the said town of Framingham the sum of forty-five hundred dollars; to the said town of Natick the sum of three thousand dollars; and to the said town of Wayland the sum of one thousand dollars; nor until said act shall have been accepted by the City Council of said City of Boston.*

HOUSE OF REPRESENTATIVES, April 2, 1859.

Passed to be enacted.

CHARLES HALE, *Speaker*.

IN SENATE, April 4, 1859.

Passed to be enacted.

CHARLES A. PHELPS, *President*.

April 5, 1859.

Approved.

NATHANIEL P. BANKS.

* Accepted by the City Council May 6, 1859. See City Records, vol. 37, p. 222.

**ACT PROVIDING FOR ADDITIONAL PENALTIES
FOR DIVERSION OR POLLUTION.**

1861.

CHAPTER 220.

AN ACT

**IN AMENDMENT OF THE ACT FOR SUPPLYING THE CITY OF BOSTON
WITH PURE WATER.**

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows :—

SECTION 1. The fifteenth section of the act entitled “An Act for supplying the City of Boston with pure water,” passed the thirtieth day of March in the year one thousand eight hundred and forty-six, is hereby amended by adding thereto the following words, viz. : “or by confinement to hard labor in the State prison, for a term not exceeding ten years.”

SECT. 2. This act shall take effect upon its passage.

HOUSE OF REPRESENTATIVES, May 22, 1861.

Passed to be enacted.

JOHN A. GOODWIN, *Speaker.*

IN SENATE, May 22, 1861.

Passed to be enacted.

WILLIAM CLAFLIN, *President.*

May 23, 1861.

Approved.

JOHN A. ANDREW.

**ACT PROVIDING FOR MAINTENANCE OF PIPES IN
MILL-DAM.**

1864.

CHAPTER 271.

AN ACT

**IN FURTHER ADDITION TO “AN ACT FOR SUPPLYING THE CITY OF
BOSTON WITH PURE WATER.”**

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows :—

SECTION 1. The City of Boston shall have the right to maintain its water pipes, as the same are now laid, in the mill-dam and other lands of the Commonwealth, in and near said city, subject to the provisions

*City may maintain
pipes on mill-dams
and other lands.*

of this act; *provided*, that any person, whose property is injured thereby, shall have his damages ascertained and paid in the manner provided in the several acts to which this is in addition; and *provided*, *further*, that if, at any time hereafter, the legislature shall order a draw to be made through the said mill-dam, or other lines on the line of said pipes, for the purposes of navigation, the City of Boston shall so adapt its said pipes, at the locality of the draw, as not to interfere with a free passage of boats and vessels through such draw.

Proviso.

SECT. 2. Said city may enter upon and dig up the ground in said mill-dam, and other lands, when necessary, for the purpose of repairing or replacing said pipes: *provided*, *however*, that said mill-dam and lands shall be restored by said city to as good order and condition as the same are in before such digging is commenced; and that the work shall be done, in such manner and with such care, as not to render any road, street or way, in which said pipes are laid, unsafe or unnecessarily inconvenient to the public travel thereon.

May enter and dig up lands.

Proviso.

SECT. 3. The City of Boston shall, at all times, save harmless and indemnify the Commonwealth, and any city or town which may become liable to keep in repair any road, street or way aforesaid, against all damages which may be recovered against them respectively, and shall reimburse to them respectively all expenses which they shall reasonably incur by reason of any defect or want of repair in such road, street or way, caused by the maintenance, repairing or replacing of said pipes, or by reason of any injury to persons or property caused by any defect or want of repair in said pipes; *provided*, that said city shall have due and seasonable notice of all claims for such damages or injury, and opportunity to make a legal defence thereto.

Indemnity for defects in highways.

Proviso.

SECT. 4. This act shall take effect upon its passage.

HOUSE OF REPRESENTATIVES, May 12, 1864.

Passed to be enacted.

ALEX. H. BULLOCK, *Speaker*.

IN SENATE, May 13, 1864.

Passed to be enacted.

J. E. FIELD, *President*.

May 13, 1864.

Approved.

JOHN A. ANDREW.

CHESTNUT-HILL RESERVOIR ACT.

1865.

CHAPTER 131.

AN ACT

TO AUTHORIZE THE CITY OF BOSTON TO BUILD AN ADDITIONAL
RESERVOIR.

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows:—

SECTION 1. The City of Boston is hereby authorized, by and through the agency of the Cochituate Water Board therein, or by and through any other agency which shall be established therefor by the City Council of said city, to construct and maintain an additional reservoir for receiving, holding and distributing water; and, for this purpose, may take and hold, by purchase or otherwise, any lands or real estate, not exceeding two hundred acres, in the towns of Newton, Brighton and Brookline, and lying between the air-line railroad, the present line of the said city's aqueduct and Beacon street on the south, Rockland and Brighton streets on the east, South street on the north, and a street leading from said South street to said Beacon street on the west; *provided, however*, that no part of the tract of land, comprising the Evergreen Cemetery in the town of Brighton, shall be so taken and held otherwise than by purchase.

City Council may direct construction of additional reservoir.

Secure lands.

Except Evergreen Cemetery.

SECT. 2. The City of Boston may also, by and through the same agency, lay and maintain one or more suitable lines of pipes from the said reservoir to a convenient point in its line of pipes leading from its reservoir in said Brookline to said city, and may take and hold, by purchase or otherwise, such lands or real estate as may be necessary therefor; and may carry and conduct the said pipes over or under any water-course, or any street, turnpike road, railroad, highway or other way, in such manner as not to obstruct or impede travel thereon; and may enter upon, and dig up any such road, street, or way, for the purpose of laying the said pipe, and for maintaining and repairing the same.

City may lay pipes.

And secure lands.

Cross water-course.

SECT. 3. The City of Boston shall at all times save harmless and indemnify any city or town which may become liable to keep in repair any road, street or way aforesaid, against all damages which may be recovered against them respectively, and shall reimburse to them respectively all expenses which they shall reasonably incur by reason of any defect or want of repair in such road, street or way, caused by the maintenance, repairing or replacing of said pipes, or by reason of any injury to persons or property caused by any defect or want of repair in said pipes; *provided*, that said city shall have due and reasonable notice of all claims for such damages or injury, and opportunity to make a legal defence thereto.

City responsible for damage in ways.

Liabie for damage
to private property.

Rights and reme-
dies.
Citizen and city to be
subject to Acts of
1846, 1849 and 1850.

City Council may
issue debt certifi-
cates.

SECT. 4. The City of Boston shall be liable to pay all damages that shall be sustained by any persons in their property by the taking of any land or real estate as aforesaid, or by any of its doings under this act; and in regard to such taking, and the ascertainment and payment of all such damages, the City of Boston, and all persons claiming damages, shall have all the rights, immunities and remedies, and be subject to all the duties, liabilities and obligations which are provided in the one hundred and sixty-seventh chapter of the acts of the year one thousand eight hundred and forty-six, the one hundred and eighty-seventh chapter of the acts of the year one thousand eight hundred and forty-nine, and the three hundred and sixteenth chapter of the acts of the year one thousand eight hundred and fifty.

SECT. 5. For the purpose of defraying all the costs and expenses of such land and real estate as shall be taken, purchased or held for the purposes mentioned in this act, and of constructing said reservoir, laying said pipes, and doing all other things incident thereto, the said City Council shall have authority to issue, from time to time, notes, scrips, or certificates of debts, to such an amount as may be necessary, and in such form, on such length of time, and bearing such rate of interest, not exceeding six per centum per annum, as they shall deem expedient.

SECT. 6. This act shall take effect upon its passage.

HOUSE OF REPRESENTATIVES, April 1, 1865.

Passed to be enacted.

ALEX. H. BULLOCK, *Speaker*.

IN SENATE, April 4, 1865.

Passed to be enacted.

J. E. FIELD, *President*.

April 4, 1865.

Approved.

JOHN A. ANDREW.

ROXBURY WATER ACT.

1867.

CHAPTER 343.

AN ACT

TO AUTHORIZE THE CITY OF ROXBURY TO PROCURE A SUPPLY
OF WATER.

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows:—

Roxbury may con-
tract with Boston or
Charlestown.

SECTION 1. The City of Roxbury is hereby authorized to contract with either the City of Boston or the City of Charlestown for a supply of water, and to take, by purchase or otherwise, and hold such land,

real estate or water-rights, and erect and maintain such works and structures as may be necessary for the introduction of water either from said City of Boston or from said City of Charlestown, or from any ponds or other sources of supply within the limits of the County of Norfolk, except Jamaica Pond, and the distribution thereof in said City of Roxbury.

SECT. 2. For the purposes of distribution, said City of Roxbury ^{May lay pipes.} may lay down pipes to any house or building in said city, the owner or owners thereof having notice and not objecting thereto, and may make and establish public hydrants in such places as may from time to time be deemed proper, and prescribe the purposes for which they may be used, and may change or discontinue the same; may regulate the ^{And regulate the} use of the water within and without the said city, and establish the ^{use of water.} prices of rents to be paid for the use thereof. And the said city may, for the purposes aforesaid, carry and conduct any aqueduct or other ^{And carry works} works by them to be made and constructed over or under any water- ^{over or under} course, or any street, turnpike-road, highway or other way, in such ^{ways, etc.} manner as not to obstruct or impede travel thereon, or the full flow of the water therein; and may enter upon and dig up any such land, street, road or way as may be necessary for the purposes of laying down said aqueducts or other works, and for maintaining or repairing the same.

SECT. 3. Three Commissioners shall be appointed by the City ^{Commissioners to} Council, who shall, during their continuance in office, execute and ^{superintend works.} perform, superintend and direct, the execution and performance of all the works, matters and things mentioned in the preceding sections, which are not otherwise specially provided for in this act; they shall be subject to such ordinances, rules and regulations, in the execution of their said trust, as the City Council may, from time to time, ordain and establish, not inconsistent with the provisions of this act and the laws of this Commonwealth; they shall respectively hold their said ^{Terms of office and} office for the term of three years next after their said appointment, ^{removals.} unless the aqueduct and works aforesaid shall be sooner completed; but they, or either of them, after having an opportunity to be heard in his or their defence, may be removed at any time by a concurrent vote of two-thirds of each branch of the City Council; and in case of a ^{Vacancies.} vacancy in the Board of Commissioners, by death, resignation, or removal, such vacancy shall be filled by the appointment of another Commissioner, in manner aforesaid, who shall hold his said office for the residue of the said term of three years, with all the powers and subject to all the restrictions aforesaid. A major part of said Com- ^{Quorum.} missioners shall be a quorum for the exercise of the powers, and the performance of the duties of the said office; they shall, once in every ^{Shall report} three months, and whenever required by the City Council, make and ^{quarterly.} present, in writing, a particular report and statement of all their acts and proceedings, and of the condition and progress of the works aforesaid.

SECT. 4. Before the appointment of the Commissioners aforesaid, ^{Salaries.} the City Council shall establish and fix the salaries or compensation

to be paid to the Commissioners for their services; and the said salaries of the said Commissioners, so established and fixed as aforesaid, shall not be reduced during their continuance, respectively, in said office.

Office ceasing.
powers of, to vest in
city.

SECT. 5. Whenever the said office of Commissioners shall cease, either by the expiration of the said term of three years from the original appointment, or by the completion of the aqueducts and works mentioned in the preceding sections of this act, all the rights, powers and authority given to the City of Roxbury by this act shall be exercised by the said city, subject to all the duties, liabilities and restrictions herein contained, in such manner and by such agents as the City Council shall from time to time ordain, appoint and direct.

City liable for
damages.

SECT. 6. The said City of Roxbury shall be liable to pay all damages that shall be sustained by any persons in their property by the taking of any land, water or water-rights, or by the constructing of any aqueducts, reservoirs or other works, for the purposes of this act. And if the owner of any land, water or water-rights, which shall be taken as aforesaid, or other person who shall sustain damage as aforesaid, shall not agree upon the damages to be paid therefor, he may apply, by petition, for the assessment of his damages at any time within three years from the taking of the said land, water or water-rights, or sustaining damage as aforesaid, and not afterwards, to the Superior Court in the county in which the same are situate, unless sooner barred, as provided in the seventh section of this act. Such

Party may apply
for assessment
within three years
to Superior Court.
Proviso.

Petition when may
be filed.
Issue and return of
summons.

petition may be filed in the Clerk's office of said court, in vacation or in term time, and the Clerk shall thereupon issue a summons to the City of Roxbury, returnable, if issued in vacation, to the then next term of the said court, and if in term time, returnable on such day as the said court shall order, to appear and answer to the said petition; the said summons shall be served fourteen days at least before the return day thereof, by leaving a copy thereof, and of the said petition, certified by the officer who shall serve the same, with the Mayor or Clerk of said city; and the said court may, upon default or hearing of the said city, appoint three disinterested freeholders of this Commonwealth, who shall, after reasonable notice to the parties, assess the damages, if any, which such petitioner may have sustained as aforesaid; and the award of the said freeholders, or of the major part of them, being returned into and accepted by the said court, shall be final, and judgment shall be rendered and execution issued thereon for the prevailing party, with costs, unless one of the said parties shall claim a trial by jury, as hereinafter provided.

Court may appoint
Assessors.

Award to be final.

Party failing to pro-
ceed, city may
commence after
three months.

SECT. 7. Whenever any damages shall have been sustained by any persons, as set forth in the sixth section of this act, and such persons shall neglect to institute proceedings against the City of Roxbury, according to the provisions of this act, for the space of twelve months, it shall be lawful for the City of Roxbury to commence such proceedings, which shall go on and be determined in the same manner as if commenced by the persons who shall have sustained such damage; and if such persons, on receiving due notice, shall not come in and prosecute

the proceedings so instituted, judgment shall be entered against them, and they shall be forever barred from recovering any damages under this act. Person not appearing to be barred.

SECT. 8. If either of the parties mentioned in the sixth section shall be dissatisfied with the amount of damages awarded, as therein expressed, such party may, at the term at which such award was accepted, or the next term thereafter, claim, in writing, a trial in said court, and have a jury to hear and determine, at the bar of said court, all questions of fact relating to such damages, and to assess the amount thereof; and the verdict of such jury, being accepted and recorded by the said court, shall be final and conclusive, and judgment shall be rendered and execution issued thereon, and costs shall be recovered by the said parties, respectively, in the same manner as is provided by law in regard to proceedings relating to the laying out of highways. Party dissatisfied may have jury trial.

SECT. 9. No application shall be made to the court for the assessment of damages for the taking of any water-rights, until the water shall be actually withdrawn or diverted by the said city, under the authority of this act. Damages for water-rights.

SECT. 10. In every case of a petition to the Superior Court for the assessment of damages, as provided in the sixth, seventh, eighth and ninth sections of this act, the City of Roxbury, by any of its officers, may tender to the complainant, or his attorney, any sum that they shall think proper, or may bring the same into court, to be paid to the complainant for the damages by him incurred or claimed in his petition; and if the complainant shall not accept the same, with his costs up to that time, but shall proceed in the suit, he shall be entitled to his costs up to the time of the tender, or such payment into court, and not afterwards; and the said city shall be entitled to recover its costs afterwards, unless the complainant shall recover greater damages than were so offered. City upon petition may tender sum.

SECT. 11. For the purpose of defraying all the costs and expenses of such lands, estates, waters and water-rights, as shall be taken, purchased or held for the purposes mentioned in this act, and of constructing all aqueducts and works necessary and proper for the accomplishment of the said purposes, and all expenses incident thereto, heretofore incurred or that may be hereafter incurred, the City Council shall have authority to issue, from time to time, scrip, notes or certificates of debt, to be denominated on the face thereof, "Water Bonds of the City of Roxbury," to an amount not exceeding five hundred thousand dollars, bearing interest at a rate not exceeding the legal rate of interest in this Commonwealth, which shall be redeemable at a period of time not less than ten, nor more than fifty years from and after the issue of the said scrip, notes or certificates, respectively; and the said City Council may sell the same, or any part thereof, from time to time, at public or private sale, or pledge the same for money borrowed for the purposes aforesaid, on such terms and conditions as the said City Council shall judge proper; and the said City Council may, for the purpose of meeting payments of such interest as may accrue upon any certificate of debt, make such further issue of scrip, notes or certificates of debt as may be necessary therefor. City Council may issue scrip. Interest and payment of principal.

May pass by-laws
and ordinances.

SECT. 12. The City Council may, from time to time, pass such by-laws and ordinances as they may deem proper for the preservation and protection of all or any of the works connected with the supplying of the City of Roxbury with pure and wholesome water, under and by virtue of this act: *provided*, such by-laws and ordinances are not inconsistent with any laws of this Commonwealth, or with the constitution thereof, subject at any time to be repealed or modified by the legislature; and may also organize a department, with full powers for the management of such works, and the distribution of the said water.

Proviso.

May organize
management.

Shall establish
water rates.

SECT. 13. The City Council shall, from time to time, regulate the price or rent for the use of the water, with a view to the payment, from the net income and receipts, not only of the semi-annual interest, but ultimately of the principal of said debt so contracted, so far as the same may be practicable and reasonable. And the occupant of any tenement shall be liable for the payment of the price or rent for the use of the water in such tenement; and the owner thereof shall also be liable, if, on being notified of such use, he does not object thereto; and if any person or persons shall use any of the said water, either within or without the said city, without the consent of the city, an action of tort may be maintained against him or them for the recovery or damages therefor.

Penalties.

SECT. 14. If any person or persons shall wilfully or maliciously divert the water, or any part thereof, of any of the ponds, streams or water-sources, which shall be taken by the city pursuant to the provisions of this act, or shall corrupt the same, or render it impure, or destroy or injure any dam, aqueduct, pipe, conduit, hydrant, machinery or other property held, owned or used by the said city, by the authority and for the purposes of this act, such person or persons shall forfeit and pay to the said city three times the amount of the damages that shall be assessed therefor, to be recovered by any proper action. And such person or persons may, moreover, on indictment and conviction of either of the wilful and malicious acts aforesaid, be punished by fine not exceeding one thousand dollars, and imprisonment not exceeding one year.

City may supply
Boston and towns.

SECT. 15. The said City of Roxbury is also authorized to supply with water, for the extinguishment of fires, or for other purposes, the City of Boston, and the towns through which the line of aqueduct may pass, and for this purpose may erect and maintain such structures as may be requisite and necessary therefor: *provided*, that such supply to Boston shall not deprive the towns on the line of the aqueduct of a sufficient supply of water.

Proviso.

Boston and Charles-
town may supply
Roxbury.

Conditions.

SECT. 16. Said City of Boston or said City of Charlestown is hereby authorized to extend its works into and through said City of Roxbury, for the purpose of supplying the latter with pure water; and to this end shall have all the rights and privileges, and be subject to all the duties, restrictions and liabilities, which it now has and to which it is now subject under the several acts authorizing it to supply itself with water; subject, however, to such terms and conditions, not inconsistent

with the provisions of said several acts, as may be agreed upon between either of said cities and said City of Roxbury.

SECT. 17. The provisions of this act shall be void, unless sub-
mitted to and approved by the voters of said City of Roxbury, at
meetings held simultaneously for that purpose in the several wards,
within three years from the passage of this act, upon notice duly given
at least seven days from the time of holding said meetings.*

SECT. 18. If within three years from the passage of this act, the
territory of the City of Roxbury shall be annexed to and made a part of
the City of Boston, then the City of Boston shall succeed to all the rights
and privileges hereby granted to the City of Roxbury.†

SECT. 19. This act shall take effect upon its passage.

HOUSE OF REPRESENTATIVES, June 1, 1867.

Passed to be enacted.

JAMES M. STONE, *Speaker*.

IN SENATE, June 1, 1867,

Passed to be enacted.

JOSEPH A. POND, *President*.

June 1, 1867.

Approved.

ALEX. H. BULLOCK.

DEER ISLAND ACT.

1869.

CHAPTER 193.

AN ACT

TO AUTHORIZE THE CITY OF BOSTON TO CONVEY WATER TO DEER
ISLAND.

*Be it enacted by the Senate and House of Representatives, in General Court
assembled, and by the authority of the same, as follows:—*

SECTION 1. The City of Boston is authorized to convey water from
East Boston, so called, to Deer Island in Boston Harbor, by laying
aqueducts or water-pipes through the town of Winthrop and across
Shirley Gut; and for that purpose shall have all the rights and privi-
leges, and shall be subject to all the liabilities mentioned in chapter
one hundred and sixty-seven of the acts of the year eighteen hundred
and forty-six, and the several acts in addition thereto. And the said
City of Boston may make any suitable structures for the purpose of
conveying the said water under the tide-waters in said Shirley Gut;
*provided, that such structures shall be approved by the Harbor Com-
missioners.*

SECT. 2. This act shall take effect upon its passage.

* This act was accepted by the citizens of Roxbury by a vote of 1,602 yeas,
to 9 nays, Nov. 5, 1867. See p. 494, Vol. VIII., City of Roxbury records.

† Roxbury was annexed to Boston, January, 1868.

HOUSE OF REPRESENTATIVES, April 20, 1869.

Passed to be enacted.

HARVEY JEWELL, *Speaker*.

IN SENATE, April 22, 1869.

Passed to be enacted.

ROBT. C. PITMAN, *President*.

April 24, 1869.

Approved.

WILLIAM CLAFLIN.

1869.

CHAPTER 447.

AN ACT

IN ADDITION TO AN ACT TO AUTHORIZE THE CITY OF BOSTON TO LAY OUT A PUBLIC STREET OR WAY ACROSS SOUTH BAY AND FOR OTHER PURPOSES.

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows:—

Boston may lay
water pipes to Pine
Island, etc.

Proviso.

SECTION 1. The City of Boston is hereby authorized to lay water-pipes from a point at or near the junction of Federal and Dorchester streets in said city, in a westerly direction, crossing the Boston, Hartford and Erie Railroad to Pine Island, so called; thence in a westerly direction crossing the marsh and the Roxbury canal to the junction of East Chester Park and Albany street, in said city; *provided*, that such pipe or pipes shall cross the Roxbury canal by means of a siphon, so as not to obstruct navigation; and shall also cross the South bay by siphon under so much of the channel as the Harbor Commissioners shall direct. And all things done under this act, so far as relates to the crossing of tide-waters, shall be subject to the determination and approval of the Harbor Commissioners, as provided in the fourth section of chapter one hundred and forty-nine of the acts of the year eighteen hundred and sixty-six.

Amendment to,
1860, 78, § 1.

SECT. 2. The act passed the present session of the Legislature, entitled, "An Act to authorize the City of Boston to lay a public street or way across South bay," is hereby amended by striking from the first section thereof the following concluding words thereof: "and, *provided*, that this act shall in no wise impair the legal rights of any person."

Construction of
street.

SECT. 3. So much of the street across South bay, mentioned in the act described in the preceding section, shall be constructed with solid filling, and so much thereof shall be a pile bridge, as the Harbor Commissioners shall direct.

SECT. 4. The City of Boston is hereby authorized to locate, construct and maintain a railroad track or tracks from some convenient point on any railroad near the street hereinbefore mentioned, near where the street hereinbefore mentioned crosses said railroad, and may extend said track or tracks in an easterly direction or westerly direction; said railroad tracks to be used only for the construction of said street. Boston may maintain railroad.

SECT. 5. All damages occasioned to private property by laying out and constructing said street shall be ascertained and compensated in the manner provided in chapter forty-three of the General Statutes for the laying out of highways. Damage to property.

SECT. 6. This act shall take effect upon its passage.

HOUSE OF REPRESENTATIVES, June 2, 1869.

Passed to be enacted.

HARVEY JEWELL, *Speaker*.

IN SENATE, June 2, 1869.

Passed to be enacted.

GEORGE O. BRASTOW, *President*.

June 2, 1869.

Approved.

WILLIAM CLAFLIN.

ACT PROVIDING FOR ADDITIONAL MAINS.

1871.

CHAPTER 185.

AN ACT

IN ADDITION TO "AN ACT TO AUTHORIZE THE CITY OF BOSTON TO BUILD AN ADDITIONAL RESERVOIR."

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows:—

SECTION 1. The City of Boston is hereby authorized, by and through the agency of the Cochituate Water Board therein, to construct an aqueduct, or to lay new main pipes from its reservoir constructed under the provisions of the one hundred and thirty-first chapter of the acts of the year eighteen hundred and sixty-five, through the towns of Brighton and Brookline, to the City of Boston, and to continue the same into and through the City of Boston, in the manner provided in the one hundred and sixty-seventh chapter of the acts of the year eighteen hundred and forty-six; and for this purpose may take and hold, by purchase or otherwise, any lands or real estate necessary therefor; and may construct said aqueduct, or lay said pipes over or under any water-course, or any streets, turnpike-roads, railroads, highways, or other City may lay new main pipes. May take lands.

ways, in such manner as not to obstruct or impede the travel thereon; and may enter upon and dig up any such roads, streets or ways, for the purpose of constructing said aqueduct, or laying down said pipes beneath the surface thereof, and of maintaining and repairing the same; but always in such manner and with such care as not to render the roads, streets and ways unsafe or unnecessarily inconvenient to the public travel thereon.

Subject to regulations of Brighton and Brookline.

And said City of Boston in performing said work shall be subject to such reasonable regulations as to time, place and manner of digging up any streets or ways of public travel for the purpose aforesaid, and the laying of said pipes as shall be made by the selectmen of Brighton and of Brookline, within their respective limits for the protection of their rights of drainage and sewerage therein.

Streets to be restored.

SECT. 2. Whenever the City of Boston shall dig up any street or way, as aforesaid, it shall restore the same to as good order and condition as the same shall be in when such digging commenced; and the City of Boston shall at all times indemnify and save harmless the town of Brighton and the town of Brookline against all damage which may be recovered against them, respectively, and shall reimburse to them, respectively, all expenses which they shall incur by reason of any defect or want of repair in any street or way, caused by the construction of said aqueduct or the laying of said pipe, or by the maintaining or repairing of the same: *provided*, that said city shall have due and reasonable notice of all claims for such damages or injury, and opportunity to make a legal defence thereto.

And towns reimbursed.

Land damages.

SECT. 3. The City of Boston shall be liable to pay all damages that shall be sustained by any persons in their property by the taking of any land or real estate, or constructing of said aqueduct, or the laying of said pipe as aforesaid; and any person sustaining damage as aforesaid may have the same ascertained, determined, collected and paid in the manner which is provided in the sixth, seventh and eighth sections of the one hundred and sixty-seventh chapter of the acts of the year eighteen hundred and forty-six.

Hydrants in Brookline.

SECT. 4. The selectmen of the town of Brighton and the selectmen of the town of Brookline may require the City of Boston, while constructing said aqueduct, or laying down said pipe, within their respective limits, to insert therein a number of hydrants, at points not less than five hundred feet apart, to be used for the purpose of extinguishing fires, and no other purpose; and the town of Brighton and the town of Brookline shall pay the expenses of keeping in repair all such hydrants as shall be so inserted, upon their respective requisitions, after the same shall have been constructed.

Act to be accepted by City Council.

SECT. 5. This act shall not take effect until the same shall have been accepted by the City Council of the City of Boston.*

* Accepted by the City Council, July 18, 1871.

HOUSE OF REPRESENTATIVES, April 10, 1871.

Passed to be enacted.

HARVEY JEWELL, *Speaker*.

IN SENATE, April 14, 1871.

Passed to be enacted.

HORACE H. COOLIDGE, *President*.

April 14, 1871.

Approved.

WILLIAM CLAFLIN.

SUDBURY RIVER ACT.

1872.

CHAPTER 177.

AN ACT

TO AUTHORIZE THE CITY OF BOSTON TO OBTAIN AN ADDITIONAL
SUPPLY OF PURE WATER.

Be it enacted, etc., as follows:—

SECTION 1. The City of Boston is hereby authorized, by and through City may take Sud-
the agency of the Cochituate Water Board, to take, hold, and convey bury river.
to, into and through said city, all the water of Sudbury river, so
called, said water to be taken at any point or points within the town of Point of taking
Framingham, or higher up on said river, and the water of Farm pond, defined.
so called, in said town of Framingham, and the waters which may flow
into and from said river and pond, and to take any water-rights in or
upon said river or pond, in or above the town of Framingham, or
connected therewith.

Said city may also take and hold, by purchase or otherwise, in con- Take lands.
nection with the said sources of supply, any lands and real estate
necessary for increasing or preserving the purity of the water, or for
laying, building and maintaining aqueducts, water-courses, reservoirs,
dams, buildings, machinery and other structures and appliances, with
their accessories, for conducting, elevating, purifying, storing, dis-
charging, disposing of and distributing water; and may also take and
hold any land, excepting any in the town of Framingham heretofore
taken or purchased by any railroad company, on the margin of said Exceptions.
sources of supply, not exceeding five rods in width from the high-
water line of said river, storage reservoirs or pond, so far as may be
necessary in the opinion of said Cochituate Water Board, for the pres-
ervation and purity of the same, for the purpose of furnishing a sup-
ply of pure water for the City of Boston.

SECT. 2. For the purposes of this act, the said city may make and May build aque-
build one or more permanent aqueducts from the aforesaid water ducts.

Dams.	sources to Chestnut-Hill reservoir, so called, or to any other reservoir owned by said city, and secure and maintain the same by any works suitable therefor; may connect the said water-sources with Lake Cochituate; may erect and maintain dams, or may increase the height of, and strengthen and maintain existing dams to raise the water above the same, or to form storage reservoirs; may make and maintain reservoirs within and without said city; may erect and maintain buildings and machinery for elevating the water, and lay down pipes for conducting the same; may build and maintain filters, or other means of purifying the water. And the city may, for the purposes aforesaid, carry and conduct any aqueduct, or other work, by it to be made and constructed, under or over any water-course, or any street, turnpike road, railroad, highway or other way, in such manner as not to unnecessarily obstruct or impede travel thereon; and may enter upon and dig up any such road, street or way, for the purpose of laying down pipes beneath the surface thereof, and for maintaining and repairing the same; and, in general, may do any other acts and things necessary or convenient and proper for the purposes of this act.
Reservoirs.	Said City of Boston, in entering upon and digging up any such road, street or way of public travel, shall be subject to such reasonable regulations as shall be made by the selectmen of the towns wherein such work shall be performed, for the protection of their rights of drainage and sewerage therein.
May construct across streams, roads, etc.	SECT. 3. The City of Boston is hereby further authorized, by and through the agency of said Cochituate Water Board, if said Board shall deem expedient, to store and distribute water for maintaining and equalizing the flow of water in the river selected by said city as its source of supply, or in the rivers into which said river may discharge, and for this purpose said city may take and hold such land and real estate as may be necessary for building and maintaining dams, reservoirs or other structures and appliances for storing and discharging water. And the said city may, through the same agency, make and build such dams, reservoirs and other structures and appliances, at any point or points upon the said Sudbury river, and upon any and all streams flowing into the same.
Dig up streets.	SECT. 4. Nothing contained in this act shall be so construed as to authorize the City of Boston to reduce the water in Sudbury river below a sufficient height to maintain at all times a running stream therein, which shall flow at least one, and one-half million gallons a day for each and every day in the year, or to draw from Farm pond or Sudbury river into Lake Cochituate when the water runs over the dam at Lake Cochituate, or to prevent the inhabitants of the towns of Framingham, Ashland, Southborough, Hudson and Westborough from taking from the Sudbury or Assabet rivers or Farm pond so much of the water hereby granted as shall be necessary for extinguishing fires, and for all ordinary domestic and household purposes, and for the generation of steam, or from cutting and carrying away ice from said pond; or as to prevent the Boston and Albany Railroad Company, or the Mansfield and Framingham Railroad Company, or the Boston,
Subject to town regulations.	
May store water.	
Take lands.	
May build structures on the river.	
May not reduce flow below one and one-half million gallons.	
Certain towns may take water.	

Clinton and Fitchburg Railroad Company from taking water from Farm pond, for use in locomotive or other engines, or for other railroad purposes, under such regulations of the City Council of the City of Boston as may be essential for the preservation of the purity of the same.

SECT. 5. The City of Boston shall be liable to pay all damages that shall be sustained by any persons in their property, by the taking of or injury to any land, real estate, water or water-rights, or by the flowage of the lands of any persons, or by the interference with, or injury to any use or enjoyment of the water of said river to which any person, at the time of such taking, is legally entitled, or by any other doings under this act; and in regard to such taking, injury, interference and flowage, and the ascertainment and payment of all such damages, the said City of Boston, and all persons claiming damages, shall have all the rights, immunities and remedies, and be subject to all the duties, liabilities and regulations which are provided in the one hundred and sixty-seventh chapter of the acts of the year eighteen hundred and forty-six, and the three hundred and sixteenth chapter of the acts of the year eighteen hundred and fifty.

City liable for damages.

Subject to Acts of 1846 and 1850.

SECT. 6. Whenever the City of Boston shall dig up any street or way, as aforesaid, it shall restore the same in as good order and condition as the same shall be in when such digging commenced; and the City of Boston shall, at all times, indemnify and save harmless the several towns within which such street or way may be, against all damages which may be recovered against them respectively, and shall reimburse to them all expenses which they shall incur by reason of any defect or want of repair in any street or way caused by the construction of any of said works, or laying of said pipes, or by the maintaining or repairing the same: *provided*, that said city shall have due and reasonable notice of all claims for such damages or injury, and opportunity to make a legal defence thereto.

To restore highways.

Hold towns harmless from damage.

Proviso.

SECT. 7. If any person or persons shall wantonly or maliciously divert the water, or any part thereof, of any of the rivers, ponds, streams or water sources, which shall be taken by the city, pursuant to the provisions of this act, or shall corrupt the same, or render it impure, or destroy or injure any dam, aqueduct, pipe, conduit, hydrant, machinery or other property held, owned or used by the said city, by the authority and for the purposes of this act, every such person or persons shall forfeit and pay to the said city three times the amount of the damages that shall be assessed therefor, to be recovered by any proper action. And every such person or persons may, moreover, on indictment and conviction of either of the wanton and malicious acts aforesaid, be punished by fine not exceeding one thousand dollars, and imprisonment not exceeding one year, or by confinement to hard labor in the State Prison for a term not exceeding ten years.

Penalty for diversion or corruption.

SECT. 8. The City of Boston is authorized, if said city shall deem it expedient so to do, to supply the towns of Framingham, Newton, West Roxbury, Brighton and Brookline, or either of them, with water, in such quantities, under such conditions, and upon such terms as may

City may supply towns.

be agreed upon between said city and said towns, or either of them; and such towns shall respectively have power to distribute the water so supplied among the inhabitants of said towns.

Commonwealth may supply State Normal School.

SECT. 9. The Commonwealth may take and convey water from said Sudbury river, or any of the reservoirs to be constructed by said city, to and for the use of the State Normal School buildings, in said town of Framingham.

SECT. 10. This act shall take effect upon its passage.

HOUSE OF REPRESENTATIVES, April 6, 1872.

Passed to be enacted.

JOHN E. SANFORD, *Speaker*.

IN SENATE, April 6, 1872.

Passed to be enacted.

HORACE H. COOLIDGE, *President*.

April 8, 1872.

Approved.

W. B. WASHBURN.

PARKER-HILL RESERVOIR ACT.

1873.

CHAPTER 287.

AN ACT

TO AUTHORIZE THE CITY OF BOSTON TO BUILD AN ADDITIONAL RESERVOIR.

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows:—

City may build reservoir on Parker Hill.

SECTION 1. The City of Boston, by and through the agency of the Cochituate Water Board therein, or by and through any other agency which shall be established therefor by the City Council of said city, may construct and maintain an additional reservoir for receiving, holding and distributing water; and for this purpose, may take and hold, by purchase or otherwise, any real estate not exceeding five acres at or near the summit of Parker Hill, so called, in Ward 15 in said city.

May lay pipes and enter upon and dig up streets.

SECT. 2. The City of Boston may, also by and through the same agency, lay and maintain one or more suitable lines of pipes from the said reservoir to a convenient point in Fisher avenue, so called, and from said point along said Fisher avenue to Parker street in said city; and may take and hold, by purchase or otherwise, such real estate as may be necessary therefor; and may carry and conduct the said pipes over or under any water-course, or any street, turnpike road, railroad, highway, or other way, in such manner as not to unnecessarily obstruct or impede travel thereon; and may enter upon and

dig up any such road, street or way, for the purpose of laying the said pipes and for maintaining and repairing the same.

SECT. 3. The City of Boston shall be liable to pay all damages sustained by any persons in their property, by the taking of any real estate as aforesaid, or by any of its doings under this act; and in regard to such taking, and the ascertainment and payment of all such damages, the City of Boston, and all persons claiming damages, shall have all the rights, immunities and remedies, and be subject to all the duties, liabilities and obligations, which are provided in the one hundred and sixty-seventh chapter of the acts of the year eighteen hundred and forty-six, the one hundred and eighty-seventh chapter of the acts of the year eighteen hundred and forty-nine, and the three hundred and sixteenth chapter of the acts of the year eighteen hundred and fifty.

SECT. 4. For the purpose of defraying all the costs and expenses of such real estate as shall be taken, purchased or held for the purposes mentioned in this act, and of constructing said reservoir, laying said pipes, and doing all other things incident thereto, the said City Council may issue, from time to time, notes, scrip or certificates of debt, to such an amount as may be necessary, and in such form, on such length of time, and bearing such rate of interest, not exceeding six per centum per annum, as they shall deem expedient.

SECT. 5. This act shall take effect upon its passage.

HOUSE OF REPRESENTATIVES, May 3, 1873.

Passed to be enacted.

JOHN E. SANFORD, *Speaker*.

IN SENATE, May 14, 1873.

Passed to be enacted.

GEORGE B. LORING, *President*.

May 14, 1873.

Approved.

W. B. WASHBURN.

WATER-BOARD ACT.

1875.

CHAPTER 80.

AN ACT

TO ESTABLISH THE BOSTON WATER BOARD.

Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows:—

SECTION 1. The City Council of the City of Boston may establish, by ordinance, a Water Board, to be known as the Boston Water Board, consisting of three able and discreet persons, to be appointed by the

City Council may establish Water Board.

Powers of Board.

Mayor, with the advice and consent of the City Council, and to receive such compensation as the City Council may from time to time determine. The said Board may be empowered by said City Council to exercise all or any of the powers conferred by the statutes of the Commonwealth upon the City of Boston, with reference to supplying said city with water, or of the Cochituate and Mystic Water Boards; and also to act as the agent of the City of Boston in doing any or all things which the city is now authorized to do in relation to the taking of lands, water rights and other property and the establishment and maintenance of works and appliances for supplying the City of Boston or other cities and towns with pure water. Said Board may also establish and regulate the price or rents for the use of said water, subject to the provisions of sections twelve and thirteen of chapter one hundred and sixty-seven of the acts of the year eighteen hundred and forty-six; and the words, "Boston Water Scrip" in said actions shall be construed to include the whole amount of outstanding loans representing the cost of the water works.

May regulate rents of water.**Cochituate and Mystic Boards abolished.**

SECT. 2. The Cochituate Water Board and the Mystic Water Board shall, upon the appointment of the Boston Water Board, as provided in the first section of this act, be thereby abolished; and the said Boston Water Board shall, so far as the City Council of said city may by ordinance prescribe, succeed to all the powers and duties formerly vested in said Cochituate Water Board and Mystic Water Board.

Salaries.

SECT. 3. The salaries of the members of the Boston Water Board shall not be diminished during the terms for which they are respectively appointed.

SECT. 4. Chapter one hundred and seventy-nine of the acts of the year one thousand eight hundred and seventy-four is hereby repealed.*

SECT. 5. This act shall take effect upon its passage.

HOUSE OF REPRESENTATIVES, March 30, 1875.

Passed to be enacted.

JOHN E. SANFORD, *Speaker*.

IN SENATE, March 31, 1875.

Passed to be enacted.

GEORGE B. LORING, *President*.

March 31, 1875.

Approved.

* The act of 1874 was identical with this act, excepting it had two additional words in the 8th line of Sect. 1, reading "and is also empowered to act, etc."

ORDINANCE.¹

SECTION 1. In the month of January, in the year eighteen hundred and seventy, and annually afterwards in said month, the city council shall elect, by concurrent vote of the two branches, one member of the board of aldermen and two members of the common council, to be members of the Cochituate water board, to hold office during the remainder of the municipal year in which they are elected, and until others are elected in their place, unless they are sooner removed. In the month of March or April, in the year eighteen hundred and seventy, and annually thereafter in March or April, there shall be elected, by concurrent vote of the two branches of the city council, two members of the Cochituate water board from the citizens at large, to hold their offices for two years from the first Monday in May in the year of their election, and until others are elected in their place, unless sooner removed. The members of said board shall at all times be subject to removal from office by the city council for cause; and vacancies from any cause may be filled at any time for an unexpired term in the same manner as the original appointment.

Water board, how
chosen, etc.
Sept. 7, 1869.

Members may be
removed for cause.
Ibid.

SECT. 2. The persons elected from the city council shall enter upon their duties as members of said water board forthwith; and the persons elected from the citizens at large shall enter upon their duties on the first Monday in May. On the first Monday in May, annually, the members shall meet and organize themselves into a board, by the choice of one of their number as President. They shall also choose a clerk, who shall not be a member of the board; and they may make such rules and regulations for their own government, and for the government of all subordinate officers appointed by them, as they may deem expedient.

Organization of the
board.
Ibid.

SECT. 3. The Cochituate water board shall have and exercise all the powers vested in the city council by an act of the legislature of Massachusetts, passed on the thirtieth day of March, in the year eighteen hundred and forty-six,

Their general
powers.
Ibid.

¹An ordinance providing for the care and management of the Boston water works, passed Sept. 7, 1869; amended Dec. 10, 1869, July 16, 1870, and November 8, 1874.

To appoint subordinate officers, etc.
Sept. 7, 1860.

entitled "an act for supplying the city of Boston with pure water," and by any acts in addition thereto, so far as the same can be legally delegated; and they shall more especially have the power to appoint all necessary subordinate officers, agents, and assistants, and may fix their compensation, and the compensation of the clerk before mentioned; *provided*, that the same shall not exceed in the whole the sum appropriated therefor by the city council; but all the powers mentioned in this section shall be subject to any limitations and restrictions contained in the ordinances, regulations, and orders of the city council.

To make annual reports.
Ibid.

Reports of city engineer and water registrar.

SECT. 4. The Cochituate water board shall, annually, during the month of May, present to the city council a report, made up to and including the thirtieth day of the preceding April, containing a statement of the condition of all the water works, and of the lands and other property connected therewith; also an account of all receipts and expenditures, together with any information or suggestions which they may deem important; and they shall, at the same time, transmit to the city council the report of the city engineer, and the water registrar, mentioned in the tenth and thirteenth sections.

Schedule of water rates.
Ibid.

SECT. 5. The Cochituate water board, whenever requested by the city council, shall prepare and send to the city council a schedule of water rates.

Cochituate water board may sell or lease property, etc.
Ibid.

SECT. 6. The Cochituate water board are authorized to sell or lease such of the property connected with the water works as they may deem expedient, subject to the approval of the mayor; and all necessary deeds and leases shall be executed by the mayor, and countersigned by the president of the board.

Bills for expenditures, how drawn, examined, etc.
Ibid.

SECT. 7. All bills for expenditures by the Cochituate water board shall be drawn for by the president, examined by the auditor, and approved by the committee of accounts, before they are paid by the treasurer.

July 16, 1870.

The pay-rolls of all the clerks, inspectors and laborers in the water department shall be made up under the direction of the Cochituate water board, and certified by the president; and upon being duly admitted and allowed, they shall be paid by the city treasurer, at such times and places as he

shall appoint, and by the agency of such of his clerks as he may delegate for that purpose.

SECT. 8. The president of the Cochituate water board shall exercise a general supervision over all the water works, and the materials and property connected therewith, and over all subordinate officers and agents. In case of his absence or inability, his duties may be performed by a president *pro tempore*, to be chosen by said board.

Duties of president of the board.

Sept. 7, 1869.

SECT. 9. The city engineer shall take charge of Lake Cochituate, the aqueducts, land, reservoirs, and other works and property connected with the water works, as the Cochituate water board may from time to time direct; and he shall perform all such services in relation thereto as may be required of him by the Cochituate water board, or the city council.

City engineer to have charge of lake, aqueducts, lands, reservoirs, etc. Ibid.

SECT. 10. The city engineer, on or before the fifteenth day of April, annually, shall present to the Cochituate water board a detailed statement of all expenditures in his department relating to the same, and such other matters as he, or the said board, may deem expedient.

To make an annual report. Ibid.

SECT. 11. There shall be elected annually, on the first Monday of February, or within sixty days thereafter, by concurrent vote of the two branches of the city council, a water registrar, who shall be a citizen of Boston. He shall hold his office for one year from the first Monday in April of the year in which he is elected, and until a successor is elected and qualified, or he is removed. He may be removed by the city council, and they may fill any vacancy at any time for an unexpired term.

Water registrar, how chosen, etc. Ibid.

SECT. 12. The water registrar, under the direction and control of the Cochituate water board, shall assess the water rates according to the tariff established by the city council.

To assess water rates. Ibid.

He shall, once in each year, personally visit, or cause to be visited, the premises of every person who takes water, and shall make out and distribute all bills for the same; and he shall exercise a constant supervision over the use of the water, and attend to the enforcement of all regulations relative thereto.

To visit premises of takers, make out bills, etc.

SECT. 13. The water registrar, on or before the fifteenth day of April, annually, shall present to the Cochituate water

To make annual report. Ibid.

Sept. 7, 1869.

board a report, containing a statement of the number of water-takers, the number of cases where the water has been cut off, the number and amount of abatements, the expenditures in his department, and such other matters as he, or the said board, may deem expedient.

Water-rent payable
in advance on the
first day of January.
Ibid.

SECT. 14. The annual rent for the use of the water shall be payable to the city treasurer in advance, on the first day of January in each year. All charges for specific supplies, or for fractional parts of the year, shall be payable in advance, and before the water is let on.

Supply to be cut off
in case of non-pay-
ment.
Ibid.

SECT. 15. In all cases of non-payment of the water-rent for sixty days after the same is due, the water registrar shall serve a summons at the premises of such delinquent; and unless said rent is paid within three days thereafter, together with twenty-five cents for said summons, the water registrar shall cut off the supply; and the water shall not be let on until the amount due, together with the twenty-five cents for said summons, and two dollars for the shutting off and letting on, is paid; *provided*, that no occupant shall be required to pay the amount due from a former occupant; and *provided, also*, that in cases of specific supplies, or when the water has been let on for fractional parts of the year, the summons may be served, and the water cut off immediately; and it shall not be let on again except upon the conditions before mentioned. The foregoing provisions shall apply when two or more parties take water through the same service-pipes, although one or more may have paid the proportion due from him or them.

Abatements may be
made.
Ibid.

SECT. 16. The water registrar, under the control of the Cochituate water board, may make abatements in the water rents, in all proper cases.

Water registrar to
keep books, etc.
Ibid.

SECT. 17. The water registrar shall keep suitable books, in which shall be entered the names of all persons who take the water, the kind of building, the name and number of the street, the nature of the use, the number of taps, and the amount charged, which books shall be always open to the inspection of the Cochituate water board and any committee of the city council. He shall perform such other services as may be required of him by the city council, or the Cochituate water board.

SECT. 18. No member of the Cochituate water board, and no person appointed to any office, or employed by virtue of this ordinance, or by the acts of the legislature mentioned in the third section, shall be interested, directly or indirectly, in any contract, bargain, sale, or agreement, in relation to the water works, or any matter or thing connected therewith, wherein the city is interested, without an express vote of the city council; and any and all contracts, bargains, sales or agreements, made in violation of this section, shall be utterly void as to the city.

No member of the board, or officer to be interested in any contract, etc., in relation to the water works.
Sept. 7, 1869.

SECT. 19. If any person shall open any hydrant within the city of Boston, or lift or remove the cover of the same, without the license of the Cochituate water board, or of the city engineers or the water registrar, except in case of fire, he shall be liable to a penalty of not less than three dollars, nor more than fifty dollars.

Penalty for opening hydrants, etc.
Ibid.

SECT. 20. If any person shall make any opening or connection with any pipe or reservoir, without the license mentioned in the preceding section, he shall be liable to a penalty of not less than three dollars nor more than fifty dollars.

For opening any pipe or reservoir, etc.
Ibid.

SECT. 21. If any person shall turn on, or turn off, the water in any of the water-pipes or reservoirs, without the license mentioned in the nineteenth section, he shall be liable to a penalty of not less than three dollars, nor more than fifty dollars.

For turning on or turning off the water, etc.
Ibid.

SECT. 22. Any person who shall injure any public reservoir, or who shall break and enter the same, and draw off, or cause to be removed, any of the water therefrom, except in case of fire, or by authority of the board of aldermen, or Cochituate water board, shall forfeit and pay a sum not less than one dollar, nor more than fifty dollars.

For injuring any reservoir, etc.
Ibid.

SECT. 23. The water shall not be sold or delivered to any parties out of the limits of the city, unless by special vote of the Cochituate water board.

Water not to be sold to parties out of the city, unless, etc.
Ibid.

SECT. 24. The following regulations shall be considered a part of the contract with every person who takes the water, and every such person, by taking the water, shall be considered to express his assent to be bound thereby. They shall be printed upon every bill for water-rent; and whenever

Regulations under which the water shall be taken.
Ibid.

Sept. 7, 1860.

any one of them is violated, the water shall be cut off from the building or place where such violation occurred, although two or more parties may receive the water through the same pipe, and shall not be let on again, except by the order of the Cochituate water board, and on the payment of two dollars ; and, in case of any such violation, the said board shall have the right to declare any payment made for the water, by the person committing such violation, to be forfeited, and the same shall thereupon be forfeited.

The said regulations are as follows :—

Takers to keep service pipes in good repair.
Ibid.

One. All persons taking the water shall keep the service-pipes within their premises, including any area beneath the sidewalk, in good repair, and protected from frost, at their own expense ; and they will be held liable for all damage which may result from their failure to do so.

To prevent waste, and use no concealment.

Two. They shall prevent all unnecessary waste of water, and shall not conceal the purposes for which it is used.

No alteration to be made, except, etc.

Three. No alteration shall be made in any of the pipes or fixtures inserted by the city, except by persons authorized by the Cochituate water board, who are to be allowed to enter the premises supplied, to examine the apparatus, the quantity of water used, and manner of its use, and to ascertain whether there is any unnecessary waste.

Water not to be supplied to other parties, unless, etc.

Four. No water is allowed to be supplied to parties not entitled to the use of it under the city ordinances, unless by special permission.

Use of hand-hose restricted.

Five. The use of the hand-hose is restricted to one hour before eight of the clock in the forenoon, and one hour after sunset.

Water registrar may enter premises to examine.

Six. The water registrar may enter the premises of any water-taker, to examine the quantity of water used, and the manner of its use.

Nov. 3, 1874.

Seven. All distributing pipes and water fixtures introduced into the premises of any water-taker shall be subject to approval by the Cochituate water board or their duly appointed agents ; and no change affecting the flow of the water shall be made in the service pipes or water fixtures already introduced, unless approved by the said water board, or their duly appointed agents.

Nothing in this section contained shall be construed to

prevent the city council from altering the foregoing regulations from time to time in its discretion.

SECT. 25. The owner and occupant of any premises in which Cochituate water is used, who fails to keep the service-pipes and fixtures in good order, and neglects to repair the same within three days after they have become defective from any cause, shall be liable to a fine of two dollars; and, in case of neglect to shut off the water after using it so that it runs to waste, said owner or occupant shall also be liable to a fine of two dollars; and, if the fine aforesaid is not paid within two days from the time when said notice is given, the water shall be cut off from the said premises, and shall not be let on again until the waste be stopped and the fine paid, together with an additional sum of two dollars for cutting off and letting on the water; and, in case of a second offence during the same year, a fine of four dollars shall be imposed, and, if not paid as before mentioned, the water shall be cut off and shall not be let on again until the cause of complaint is removed, and the fine paid, together with two dollars for cutting off and letting on the water; and, in case of a third or subsequent offence, the water shall be cut off and shall not be let on again except by a vote of the Cochituate water board, and the payment of such fine, not exceeding ten dollars, as the said board may impose.

Waste of water, fine and penalty for. Sept. 7, 1866.

SECT. 26. No hose shall be attached or used in any stable for washing horses or carriages, or for any other purpose whatsoever, except for extinguishing fires, under a penalty of ten dollars for each offence; and, if this penalty is incurred and is not paid within two days after demand for the same made at such stable, the water shall be cut off from such stable, and shall not be let on again until said penalty is paid, and also the additional sum of two dollars for cutting off and letting on the water.

Hose not to be used for washing horses, carriages, etc., fine and penalty for. Ibid.

SECT. 27. The following rates shall be charged annually for the use of the Cochituate water: Every dwelling-house, including the land under, and used in connection with the same, shall be charged, when they are valued for the assessment of taxes at \$1,000, or any less sum, and occupied by one family only, *six dollars*; and for every additional \$1,000, or fractional part thereof, *one dollar*, until the valuation for

Water rates for dwelling-houses.

Sept. 7, 1869.

the assessment of taxes shall amount to \$25,000; and for every family more than one in a dwelling-house, the charge shall be for each *two dollars*.

Nov. 3, 1874.

In addition to the foregoing rates, there shall be charged to each dwelling-house with one family, from one dollar to ten dollars for each water closet and each bath tub in use, according to the amount of water used; and for each family, more than one, the annual charge shall be, for each, two dollars additional.

Rates for model
houses.
Sept. 7, 1869.

SECT. 28. For the use of Cochituate water in model or tenement houses, which are rented in suites of rooms to different families, the rate of charge for each such tenement shall be based upon the rental of such tenement, viz.: Every tenement occupied, and having a faucet within the same, shall be charged *three dollars* annually, and *fifty cents* additional on every one hundred dollars, or fraction of one hundred dollars, rent above three hundred dollars; *provided*, that the said rate may be based upon the estimated yearly rentable value of each such tenement. In addition to the foregoing rate, there shall be charged to each tenement from one to ten dollars for each water-closet and each bath-tub in use, according to the amount of water used.

Nov. 3, 1874.

Each tenement in which there are no water fixtures, the occupants taking the water from taps in common with other tenants of the house, shall be charged *two dollars* annually; and an additional charge of *two dollars* annually shall be made to each tenement, the occupants of which use a water-closet in common with other tenants.

Rates for offices.
Sept. 7, 1869.

SECT. 29. The following rates shall be charged for the use of Cochituate water in buildings occupied for offices, or by different tenants for business purposes, viz.: For each office or tenement having a faucet within the same, *three dollars* annually; and for each office or tenement not having water within the same, but taking it from faucets in common with other tenants, *two dollars* annually. And in addition to these rates there shall be charged for each water-closet in use within the office or tenement, from one to ten dollars, according to the amount of water used; and when the water-closet is located so as to be used in common, the charge for each

Nov. 3, 1874.

office or tenement shall be from one to ten dollars, according to the amount of water used.

SECT. 30. Hotels, taverns, and boarding-houses (said boarding-houses being valued for the assessment of taxes over \$15,000), not including water for baths or for uses without the house, shall be charged, for each bed for boarders and lodgers within the same, *three dollars*; *provided*, that in no case shall any hotel, tavern, or boarding-house, be charged less than if occupied as a private dwelling-house.

Rates for hotels,
etc.
Sept. 7, 1869.

SECT. 31. Each tenement occupied as a store, warehouse, office, shop, or for purposes not included in any other classification, and not requiring more than an ordinary supply of water, shall be charged from *six to twenty-five dollars*. For each water-closet more than one, supplied for the above, there shall be charged *five dollars* additional. And for each urinal, wash-hand basin or sink, more than one, *two dollars and fifty cents* additional.

Rates for stores,
shops, etc.
Ibid.

SECT. 32. Private stables, including water for washing carriages, shall be charged *six dollars*; and for each horse over two, the charge shall be *two dollars*. Livery stables, including water for washing carriages, shall be charged, for each horse, *two dollars*. Omnibus stables shall be charged, for each horse, *one dollar and fifty cents*. Truckmen's stables shall be charged, for each horse, *one dollar and twenty-five cents*; *provided*, that in no case shall any stable be charged less than *five dollars*.

Rates for stables,
etc.
Ibid.

SECT. 33. There shall be charged for the right to attach a hose, of not more than five-eighths of an inch orifice, for washing windows or sprinkling streets, in addition to the charge for other uses, from *five to fifty dollars*, according to the amount of water used. But no hose shall be attached, or used in any stable, for washing horses or carriages, or for any other purpose whatever, except for extinguishing fires.

Hose for washing
windows and
sprinkling streets.
Ibid.

Nov. 3, 1874.

SECT. 34. Refectories, confectioneries, eating houses, market and fish stalls, provision shops, refreshment and oyster saloons, according to the quantity of water used, shall be charged from *eight to fifty dollars*.

Refectories, eating-
houses, stalls, pro-
vision shops, sal-
oons, etc.
Sept. 7, 1869.

SECT. 35. Public baths shall be charged for each tub *five dollars*.

Baths.
Ibid.

SECT. 36. Every printing office, according to the number

Printing offices.
Ibid.

Sept. 7, 1880.

of presses used, not including the supplying of a steam-engine, shall be charged from *six dollars to forty dollars*.

Steam-engines.
Ibid.

SECT. 37. Stationary steam-engines, working not over twelve hours a day, shall be charged by the horse-power as follows: For each horse-power up to and not exceeding ten, the sum of *ten dollars*; for each exceeding ten, and not over fifteen, the sum of *eight dollars*; for each horse-power over fifteen, the sum of *six dollars*.

Steamboats.
Ibid.

SECT. 38. Steamboats shall be charged, for estimated quantities of water used for boiler and other purposes, at the rate of *six cents per one hundred gallons*; *provided, however*, that in cases where meters are applied, the charge shall be *three cents per one hundred gallons*.

Building purposes.

SECT. 39. For building purposes there shall be charged for the water used with each cask of lime or cement, *seven cents*.

Private fountains.
Ibid.

SECT. 40. Fountains are to be supplied with water at the discretion of the Cochituate water board; and the charge shall be upon the estimated quantity used, namely, for each one hundred gallons, daily consumption, *five dollars per annum*.

Bakeries.
Ibid.

SECT. 41. Bakeries shall be charged according to the average daily use of flour, namely, for each barrel per day the sum of *three dollars per annum*; *provided*, that in no case shall any bakery be charged less than *six dollars*.

For manufacturing
and other business.
Ibid.

SECT. 42. Manufacturers and other persons supplied with water through meters or by estimated quantity, shall be charged at the rate of *three cents per one hundred gallons*.

For purposes not
specified, how fixed.
Ibid.

SECT. 43. When water is required for purposes which are not specified in the foregoing tariff, the rate shall be fixed by the Cochituate water board.

For estates valued
together.
Ibid.

SECT. 44. Whenever two or more dwelling-houses, or other estates, are valued together for the assessment of taxes, the water registrar, under the direction of the Cochituate water board, shall make a separate valuation of the same; and whenever a portion only of any estate is justly chargeable for any water-rate, the water registrar shall make a proper valuation of the said portion; and the water-rates hereinbefore provided shall apply to such valuations respectively.

SECT. 45. The Cochituate water board shall have power to ascertain by meters the quantity of water used in any case; and the proprietors or occupants of hotels, taverns, boarding-houses, or any other establishment using large quantities of water, shall also have authority to place within their premises, at their own expense, a sufficient water meter, to be approved by the water registrar, for the purpose of measuring the quantity of water by them respectively used. The charge for the use of water by meter shall be *three cents for one hundred gallons*, to be collected quarterly by the water registrar; and all such bills shall be paid within ten days thereafter, or the water registrar shall cut off the supply, after sending a summons, as provided in section fifteen.

Board may ascertain by meters, water used.
July 16, 1870.

SECT. 46. For the use of water from hydrants and reservoirs, in extinguishing fires, the fire department shall be charged for each hydrant and reservoir established within the limits of the city, the sum of *eighteen dollars* per annum; and for furnishing said hydrants and keeping them and the reservoirs in repair and ready for use, the fire department shall be charged, for each hydrant and reservoir established within the limits of the city, the sum of *twelve dollars* per annum.

For the fire department.
Dec. 10, 1869.

SECT. 47. For water supplied for fountains and other public purposes, the water board may charge the department of the government ordering the water at the same rate that individuals or corporations are charged for water supplied for similar purposes.

For public fountains and other public purposes.
Ibid.

SECT. 48. No charge shall be made for the right to insert a pipe of not more than one inch in diameter, at the expense of the water-taker and to be used only in case of fire.

No charge for pipes to be used only in case of fire.
Sept. 7, 1869.

SECT. 49. Whenever application is made to the Cochituate water board by parties who have built, or may intend to build, upon unaccepted streets, for an extension of the water-pipes, or the use of the Cochituate water from pipes already laid, the said board shall refuse such application, unless, upon an examination of the premises by the city engineer, it is found that the street is properly graded, to a level of at least eighteen feet above mean low water, and that the cellars and yards are filled with material, satisfactory

Pipes not to be laid in unaccepted streets, unless properly graded.
Ibid.

Sept. 7, 1869.

to said board, to a level of at least twelve feet above mean low water.

Repeal of former ordinance.
Ibid.

SECT. 50. The ordinance providing for the care and management of the Boston water works, passed the thirty-first day of October, A. D. eighteen hundred and fifty, and all ordinances in addition thereto, and amendatory thereof, are hereby repealed; said repeal to take effect on the first day of January, A. D. eighteen hundred and seventy.

NOTE.—By ordinance of May 24, 1872, and Nov. 5, 1873, the records and files of the several departments, including the water department, were made open for public inspection and examination.

AN ORDINANCE

TO ESTABLISH THE BOSTON WATER BOARD.

Be it ordained by the Aldermen and Common Council of the City of Boston in City Council assembled, as follows:—

Election of members.
March 22, 1876.

SECTION 1. In the month of April in the year 1876, or as soon thereafter as may be, the mayor shall appoint, subject to the approval of the city council by vote taken by ballot in each branch thereof by yea and nay, three persons to constitute the Boston water board. One member of said board shall be appointed to hold his office until the first Monday in May in the year 1877; one until the first Monday in May in the year 1878; and one until the first Monday in May in the year 1879. In the month of April in the year 1877, and annually thereafter in the month of April, the mayor shall appoint, subject to like approval, one person to be a member of said board for the term of three years from the first Monday in the following May. Any member of said board may at any time be removed by the mayor with the consent of the city council, or he may be removed by vote of two-thirds of the whole of each branch of the city council by vote taken by yea and nay. All vacancies occurring in said board shall be filled, for the unexpired term, in the same manner in which the original appointments are herein directed to be made.

Removal from office.

Vacancies.

Organization.
Ibid.

SECT. 2. The said board, when first appointed, shall meet and organize forthwith by the choice of one of its members

as chairman ; and annually afterwards on the first Monday in March 22, 1876. May the said board shall organize in like manner. The members of said board shall devote their time to the duties of their office, and shall not actively engage in any other business. They shall receive such compensation for their services as the city council may from time to time determine. They shall choose a clerk, who shall not be a member of the board, shall fix his compensation, and may remove him at pleasure ; and they shall make such rules and regulations as they may deem expedient for their own government and for the government of all subordinate officers appointed by them. They shall preserve complete records of their meetings, giving the names of the members present, and their votes and doings thereat ; and they shall, whenever requested, exhibit to the mayor or to any member of the city council said records, and also any and all books, papers, and documents belonging to that department.

Shall choose a clerk.

Make rules and regulations.

And preserve records.

SECT. 3. The said board, as hereby constituted, shall have and exercise all the powers vested in, and shall perform all the duties prescribed to, the Cochituate and Mystic water boards by statutes and ordinances now in force ; subject, however, to the authority of the city council from time to time by ordinances, orders, or resolutions to instruct said board, and to change and limit its powers ; and said board shall have power to appoint such subordinate officers, agents, and assistants, in addition to the engineer and water registrar elected by the city council, as it may deem necessary, and may fix their compensation ; provided that the expenditures incurred by it shall not exceed in the aggregate the sums previously appropriated or authorized by the city council for the care, maintenance, repair, or enlargement of the water works.

Powers of board. Ibid.

Shall appoint subordinate officers.

SECT. 4. The account of expenses and revenue of the Mystic water works shall be kept separate and distinct from the other accounts of the water department ; and the excess, if any, of such revenue over expenditure and interest on loans shall be paid to the sinking fund commissioners for the redemption of any loans heretofore made or hereafter to be made on account of said works. All existing contracts for the supply of water from said works

Mystic accounts to be kept separate. Ibid.

Existing contracts.

March 22, 1876.

to other cities and towns shall continue in force, and shall not be modified or annulled except by an order of the Boston water board, approved by a vote of the city council.

City Engineer.
Ibid.

SECT. 5. The city engineer shall be the engineer of the Boston water board, and shall, under the direction of said board, have the general superintendence of all works in the water department.

Purchases exceed-
ing \$10,000 to be
advertised.
Ibid.

SECT. 6. No contract or purchase which shall be estimated to involve an expenditure of more than ten thousand dollars shall be made by the said board, unless it shall first advertise for sealed proposals therefor. Whenever advertisements for proposals are made, plans and specifications of the work to be done, and schedules of the materials or supplies to be furnished, shall be placed on file in such office as may be designated by said board, and shall at all times during office hours be open to public inspection. The

Advertisements how
made.

advertisements shall in all cases be inserted not less than five times in each of three newspapers published in the city of Boston, and they may be inserted also in newspapers of other cities or towns, if said board shall deem it expedient, and the last publication of any advertisement shall be at least one week before the time fixed for opening the proposals. Each proposal shall conform to the specifications and requirements of the advertisement, and shall be enclosed in a sealed envelope directed to said board. It shall be accompanied by a bond to the city with sufficient sureties, in such sum, not less than five hundred dollars, as said board may specify in its advertisement, and conditioned to be void if the party making the proposal shall, in case of the acceptance of his bid, sign and deliver to said board, within the time required in the advertisement, a contract for the performance of the subject-matter of his proposal, and if he shall also, at the time of the delivery of such contract, give a further bond, with satisfactory sureties, for the performance of such contract.

Proposals to be
accompanied by
bond.

Or other security.

Instead of the before-mentioned bond to accompany a proposal, a deposit of money or other collateral, satisfactory to said board, may be made as security for the signing and delivery of the contract and of the bond for the performance thereof. For the performance of any contract, a bond with

sureties shall in all cases be required when the contract is signed and delivered. March 22, 1876.

All proposals shall be publicly opened at the hour and place designated in the advertisement. Bids to be publicly opened.

The provisions of this section shall not be construed to prevent said board from rejecting any or all bids which may be offered under its advertisements; and it shall be the duty of said board to reject all bids of irresponsible parties.

SECT. 7. The said board shall annually, on or before the 15th day of February, send to the joint standing committee of the city council on the water department an estimate in detail of the appropriations required by its department during the financial year next ensuing, and also an estimate of the income to be derived during such year from water-rents and from other sources. All bills for expenditures from the appropriations for the water department shall, before they are paid by the treasurer, be drawn for by said board, examined by the auditor of accounts, and approved by the committee on accounts. Annual estimate. Ibid. Bills, how drawn.

SECT. 8. The said board shall annually, in the month of May, present to the city council a report, made up to and including the thirtieth day of the preceding April, and containing a full and comprehensive statement of the acts of said board during the preceding year, and of the condition of the water works at the time of the report, together with such other information or suggestions as said board may deem proper; and it shall at the same time transmit to the city council reports from the city engineer and from the water registrar. Annual report. Ibid.

SECT. 9. There shall be appointed annually, in the month of January, a joint committee of the city council on the water department, consisting of two members of the board of aldermen, and three members of the common council. It shall be the duty of said committee to examine, as often as once in each month, the records, accounts, and contracts of the Boston water board, and all requests for appropriations for said department shall be examined and reported upon by the said committee before they are acted upon by the city council. Joint Committees of the City Council. Ibid. To examine accounts.

Cochituate and
Mystic Boards to
cease.
March 22, 1876.

SECT. 10. Upon the first organization of said board, official notice thereof shall be sent by its president to the Cochituate and Mystic water boards, and upon the receipt of said notice the said last-named boards shall cease to exercise any of the powers, or to be subject to any of the duties (except that of presenting to the city council their annual reports for the year ending April 30, 1876), heretofore vested in or imposed upon them, and shall deliver to the said Boston water board all the official books, accounts, maps, deeds, records, contracts, and papers in their possession, and also all property of whatever description belonging to the city of Boston, which shall then be under their care and custody.

To deliver books,
etc.

Inconsistent ordi-
nances repealed.
Ibid.

SECT. 11. All ordinances or parts of ordinances inconsistent with this ordinance are hereby repealed, such repeal to take effect upon the organization of the Boston water board, as herein provided. The subordinate officers, assistants, and agents holding office in the water department, by appointment of the Cochituate water board or of the Mystic water board, shall continue to hold their respective offices until their successors shall be appointed, or until they shall, be themselves removed. The present joint standing committee of the city council on the water department shall, during the remainder of this municipal year, perform all the duties imposed by this ordinance upon the joint committee on the water department.

Officers to hold
over.

AN ORDINANCE

FOR THE REGULATION OF CHESTNUT-HILL RESERVOIR
AND THE GROUNDS CONNECTED THEREWITH.

*Be it ordained by the Aldermen and Common Council, in
City Council assembled, as follows:—*

Fishing or gunning.
May 30, 1876.

SECTION 1. No person shall fish in the Chestnut-Hill reservoir, or discharge any gun or firearm on the same, or on the grounds connected therewith.

Bathing, boating,
etc.
Ibid.

SECT. 2. No person shall bathe in the Chestnut-Hill reservoir, or place or use any boat therein, or throw any

dirt, rubbish, filth or offensive matter, or commit any nuisance therein. May 30, 1876.

SECT. 3. No person shall drive any team, cart, wagon or other vehicle, for the conveyance of burdens, upon the driveway, or within the grounds of the Chestnut-Hill reservoir. Teaming.
Ibid.

SECT. 4. No person shall drive or conduct any funeral, or any hearse or carriage connected with a funeral, on the driveway of the Chestnut-Hill reservoir. Funerals.
Ibid.

SECT. 5. No owner or other person, having for the time being the charge or use of any horse or other animal, shall drive or permit such horse or animal to go at a greater rate of speed than eight miles an hour upon the driveway or within the enclosure of Chestnut-Hill reservoir. Fast driving.
Ibid.

SECT. 6. No person shall injure, deface, or destroy any tree, shrub, grass, path, or fence, on the grounds connected with the Chestnut-Hill reservoir, or dig or carry away any of the sward, gravel, rock, stones, sand, turf, or earth therein, or commit any nuisance thereon. Defacing trees, etc.
Ibid.

SECT. 7. No person shall climb any tree on the grounds connected with the Chestnut-Hill reservoir, or tie any horse or other animal to any of said trees, or to any fence on said premises. Climbing trees.
Ibid.

SECT. 8. No person shall post any bills, placards, or advertisements within the grounds connected with the Chestnut-Hill reservoir. Posting bills.
Ibid.

SECT. 9. Any person violating any of the provisions of this ordinance shall be liable to a penalty of not less than five nor more than fifty dollars for each offence. Penalty.
Ibid.

RULES AND REGULATIONS OF THE COCHITUATE WATER BOARD.

COCHITUATE WATER BOARD.

The persons chosen by the City Council to constitute the Cochituate Water Board shall meet on the first Monday in May in each year, and organize themselves by the choice of a President from their own number, and of a Clerk, by ballot, and shall make such rules and regulations for their own government, and in relation to all subordinate officers, as they may deem expedient.

DUTIES OF THE PRESIDENT.

The President shall preside at all meetings of the Board, and in his absence a President *pro tem.* shall be chosen. He shall exercise a general supervision over all the water works, and the materials and property connected therewith, and over all subordinate officers and agents of the Board. He shall sign all contracts, deeds and other instruments authorized by the Board. He shall sign the monthly draft on the treasury, and deliver it, with the vouchers, to the Auditor, previous to the 20th of each month.

At the annual, or the next meeting thereafter of the Board, the President shall appoint the following standing committees, consisting of three members each, who shall have the special care and control of the several departments to which they are appointed, viz. : —

Committee on the Western Division.

Committee on the Eastern Division.

Committee on the Water Registrar's office, and the office of the Water Board.

Also, such special committees as may be required or deemed advisable.

COMMITTEES.

All petitions and subjects presented to the Board shall (unless they are prepared to act thereon) be referred to a committee, to be reported upon at the next regular meeting, or at a special meeting called for the purpose. All bills and accounts incurred by direction of the several committees must be examined and approved by the Chairman, or, in his absence, by a member of the committee. Committees shall report upon all matters referred to them at the next succeeding meeting of the Board, unless full powers are conferred by vote of the Board. All business referred by the

Board to any standing or special committee shall be acted upon and disposed of only at a meeting of the committee.

MEETINGS.

Stated meetings of the Board shall be held semi-monthly, at such day and hour as they may direct. Special meetings may be called by the President, or by any two members. A majority of the Board shall constitute a quorum. The order of business shall be as follows : —

Reading the record.

Reports of Committees.

Examination of Claims.

Motions and Resolutions.

All meetings of the Board shall be notified, by the Clerk sending a notice to the residence of each of the members, unless otherwise directed. When requested by a member of the Board, the vote shall be taken by yeas and nays, and recorded by the Clerk.

DUTIES OF THE CLERK.

The Clerk shall be chosen by ballot, and be duly sworn to the faithful performance of the duties of his office. He shall give his whole time to the service of the Board, attend their meetings, and keep a record of their proceedings. He shall receive all bills and accounts incurred by the Board, examine them in detail, and when indorsed by the authorized person and chairman of the committee as correct, shall present them, with a schedule thereof, to the President for his approval, after which he shall enter them in their proper books, and upon the monthly draft. He shall receive all applications for extension of service pipes, and for water to be let on or shut off, and keep a record of the same, specifying the time and reasons therefor; cause the water to be let on when the rates or fines are paid, and when notified by the Registrar of non-payment, at once cause it to be shut off. He shall have charge of the books, plans, and documents, belonging to the Board, and shall also perform such further services as, from time to time, may be required by the President or the Board.

CLERK OF COMMITTEES.

The Clerk of Committees shall be chosen by ballot, and it shall be his duty to notify all meetings of committees; be present at the meetings and keep a record of their proceedings, in separate books, for each com-

mittee. He shall keep a list of, and the papers relating to, the business referred to each committee by the Board, for the information and use of the committee. He shall also copy in proper books all contracts, deeds of land, claims allowed for damages, leases and other important papers on business connected with the Board ; and perform such other clerical duties as may be required by the President or committees.

OFFICERS.

On the first Monday in May, or within thirty days thereafter, the following subordinate officers shall be elected by ballot, to hold their offices during the pleasure of the Board, and they shall receive such compensation as the Board may from time to time deem proper, viz. :—

A Superintendent of the Western Division.

A Superintendent of the Eastern Division.

The Board may also elect or appoint, from time to time, such clerks, agents, and assistants as they may deem necessary.

WESTERN DIVISION.

The Superintendent, under the direction of the President and the Committee on the Western Division, shall have the charge of Lake Cochituate, Brookline and Chestnut-Hill reservoirs, gate-houses and pipe-chambers at Charles river, and of all the lands and property of the city in this division.

It shall be his special duty to attend to the protection of the above lands and property ; the waste weirs at Dedman's brook, in Needham, Webber's barn in Brookline, at Newton Centre and East Needham ; to the prevention of all nuisances and trespasses upon all the said works or lands, or upon the waters of the lake ; keep the grounds and walks in good order, and forthwith report to the committee, and at the office, all cases of damage or casualty ; make an accurate record of the water levels at the lake every morning, specifying therein the depth of the water in the conduit, the height of the surface of the lake above the conduit, and the temperature of the water in the gate-house, of the air in the shade, and the height of the water on the 23-feet gauge below the outlet dam ; also at the Brookline and Chestnut-Hill reservoirs, specifying therein the depth of the water above the bottom of the conduit in the reservoirs, the depth in the gate-houses, the temperature of the water and of the air in the shade ; ascertain the height of water at the pipe-chambers at Charles river daily, every morning, above the bottom of the aqueduct, and report the same to the

Board weekly, and to the City Engineer monthly ; employ such assistants and laborers as may be required, first obtaining the consent and approval of the committee on this division. He shall annually, on the first of May, return to the Board a full report of the work and labor performed, and materials used in his department, and a correct statement of all the tools and other property in his possession belonging to the city, and perform such further services as may be required.

EASTERN DIVISION.

The Superintendent, under the direction of the President and the Committee on the Eastern Division, shall have the special charge of the machine shop, pipe yards, all the reservoirs, and of the public fountains in the city, and of all the iron mains and pipes in both divisions ; and it shall be his duty to protect them from all nuisances and trespasses, and attend to the protection of all other property in this division belonging to the Water Works. He shall keep an account of the pipes, machinery, and other property in the machine shop and yards, and, in case of accident to the mains or other pipes, forthwith repair them, distributing suitable notices before the stoppage of water, except in cases of emergency ; give immediate notice at the office and to the committee of any accident which may happen to the mains, pipes, or anything connected therewith ; put in such service pipes, and lay such mains and other pipes, as may from time to time be directed ; repair any injuries to the streets or sewers caused by the Water Works ; employ such assistants and laborers as may be required, first obtaining the consent and approval of the committee. Whenever any street, highway, or place is liable to be obstructed or rendered dangerous by the laying of pipes or making repairs, cause a sufficient fence to be erected, and light and guard the same ; make a full report annually to the Board of the work and labor performed, and materials used in his department ; measure the quantity of water in the reservoirs ; take the temperature of the water in the Beacon-Hill reservoir, and of the air in the shade, every morning, noon and night, and keep a record, and make a return thereof to the Board weekly, and to the City Engineer monthly ; duly return to the Board, on the first of May in each year, and as much oftener as they may require, a correct statement of the quantity of pipes and other materials in the yards, and all the property belonging to the city which is under his care, and perform such further services as may be required.

CITY ENGINEER.

It shall be the duty of the City Engineer to carefully inspect the aqueduct, and all other structures belonging to the Water Works, in person, previous to making his annual report to the Board, and at such other times as they may require ; make such surveys, plans and estimates, connected with the works, as the Board may direct ; when requested, give his opinion, in writing, of the best mode of constructing or repairing any portion of the works ; keep in his office the returns of the Superintendents in relation to the water levels at the lake, the reservoirs, and the pipe-chambers at Charles river, and report them to the Board on the first day of May in each year.

WATER REGISTRAR.

It shall be the duty of the Water Registrar, under the direction of the Board and the committee on this department, to assess the water rates, according to the tariff established by the City Council ; make out and distribute all bills for the same ; exercise a constant supervision over the use of the water, and attend to the enforcement of all regulations relative thereto ; keep suitable books, in which shall be entered the names of all persons who take water, the kind of building, the name and number of the street, the nature of the use, the number of taps, and the amount charged, which shall always be open to the inspection of the Board ; make returns to the Clerk of the Board, of all places where the water is to be let on, and where to be shut off for non-payment, with full particulars as to the location of the premises ; make monthly returns to the Board of the receipts and expenditures of his department, and as much oftener as they may require. He shall annually, on the first of May, report to the Board the number of water-takers ; the amount received for water-rates ; the number of meters used and applied during the year ; the number and kind of water-fixtures ; and a classified list of the buildings and the purposes for which the water is used. He shall employ such assistance as may be necessary in his department, first obtaining the approval of the committee, and perform such other services as may be required.

He shall make no abatement of water-rates after a bill has been rendered, nor apply any meter, or discontinue the use of any, without the approval of the President or the committee.

BILLS AND ACCOUNTS.

All bills and accounts authorized by this Board, after being approved by the chairman of the committee ordering the same, shall be presented to

the President by the Clerk, previous to the 20th of each month ; and after the same shall have been approved by the President, they shall be entered by the Clerk in the proper books ; and a monthly draft for the amount shall be signed by the President, and delivered, with the vouchers, to the City Auditor.

All bills and accounts to be entered in the monthly draft, must be delivered to the Clerk on or before the fifteenth day of that month.

AMENDMENTS.

The foregoing Rules and Regulations may be suspended by vote of a majority of the members present, and they may be amended by a majority of the whole Board ; notice of the proposed amendments having been given at the previous meeting of the Board.

APPENDIX.

STATISTICAL INFORMATION AND TABLES.

APPENDIX.

CIVIL ORGANIZATION OF THE WATER WORKS FROM THEIR COMMENCEMENT, TO MAY 1st, 1876.

WATER COMMISSIONERS.

NATHAN HALE, JAMES F. BALDWIN, THOMAS B. CURTIS. From May 4, 1846, to January 4, 1850.

ENGINEERS FOR CONSTRUCTION.

JOHN B. JERVIS, of New York, Consulting Engineer. From May, 1846, to November, 1848.

E. S. CHESBROUGH, Chief Engineer of the Western Division. From May, 1846, to January 4, 1850.

WILLIAM S. WHITWELL, Chief Engineer of the Eastern Division. From May, 1846, to January 4, 1850.

CITY ENGINEERS HAVING CHARGE OF THE WORKS.

E. S. CHESBROUGH, Engineer. From November 18, 1850, to October 1, 1855.

GEORGE H. BAILEY, Assistant Engineer. From January 27, 1851, to July 19, 1852.

H. S. MCKEAN, Assistant Engineer. From July 19, 1852, to October 1, 1855.

JAMES SLADE, Engineer. From October 1, 1855, to April 1, 1863.

N. HENRY CRAFTS, Assistant Engineer. From October 1, 1855, to April 1, 1863.

N. HENRY CRAFTS, City Engineer. From April 1, 1863, to November 25, 1872.

THOMAS W. DAVIS, Assistant Engineer. From April 1, 1863, to December 8, 1866.

HENRY M. WIGHTMAN, Resident Engineer at C. H. reservoir. From February 14, 1866, to November, 1870.

JOSEPH P. DAVIS, City Engineer. From November 25, 1872, to present time.

A. FTELEY, Resident Engineer on construction of the Sudbury river conduit, from May 10, 1873, to present time.

After January 4, 1850, Messrs. E. S. CHESBROUGH, W. S. WHITWELL, and J. AVERY RICHARDS, were elected a Water Board, subject to the direction of a Joint Standing Committee of the City Council, by an ordinance passed December 31, 1849, which was limited to keep in force one year; and in 1851 the Cochituate Water Board was established.

COCHITUATE WATER BOARD.

PRESIDENTS OF THE BOARD.

THOMAS WETMORE, elected in 1851, and resigned April 7, 1856 * *	Five years.
JOHN H. WILKINS, elected in 1856, and resigned June 5, 1860 * *	Four years.
EBENEZER JOHNSON, elected in 1860, term expired April 3, 1865	Five years. .
OTIS NORCROSS, elected in 1865, and resigned January 15, 1867	One year and nine months. ,
JOHN H. THORNDIKE, elected in 1867, term expired April 6, 1868	One year and three months.
NATHANIEL J. BRADLEE, elected April 6, 1868, and resigned January 4, 1871	Two years and nine months.
CHARLES H. ALLEN, elected from January 4, 1871, to May 4, 1873	Two years and four months.
JOHN A. HAVEN, elected from May 4, 1873, to December 17, 1874 * *	One year and seven months.
THOMAS GOGIN, elected December 17, 1874, and resigned May 31, 1875	Six months.
L. MILES STANDISH, elected August 5, 1875, to July 31, 1876	One year.

MEMBERS OF THE BOARD.

THOMAS WETMORE, 1851, 52, 53, 54 and 55 * *	Five years.
JOHN H. WILKINS, 1851, 52, 53, *56, 57, 58 and 59 * *	Eight years.
HENRY B. ROGERS, 1851, 52, 53, *54 and 55	Five years.
JONATHAN PRESTON, 1851, 52, 53 and 56	Four years.
JAMES W. SEVER, 1851 * *	One year.
SAMUEL A. ELIOT, 1851 * *	
JOHN T. HEARD, 1851	One year.
ADAM W. THAXTER, Jr., 1852, 53, 54 and 55 * *	Four years.
SAMPSON REED, 1852 and 1853	Two years.
EZRA LINCOLN, 1852 * *	One year.
THOMAS SPRAGUE, 1853, 54 and 55 * *	Three years.
SAMUEL HATCH, 1854, 55, 56, 57, 58 and 61	Six years.
CHARLES STODDARD, 1854, 55, 56 and 57 * *	Four years.
WILLIAM WASHBURN, 1854 and 55	Two years.
TISDALE DRAKE, 1856, 57, 58 and 59 * *	Four years.
THOMAS P. RICH, 1856, 57 and 58	Three years.
JOHN T. DINGLEY, 1856 and 59	Two years.
JOSEPH SMITH, 1856	Two months.
EBENEZER JOHNSON, 1857, 58, 59, 60, 61, 62, 63 and 64	Eight years.
SAMUEL HALL, 1857, 58, 59, 60, 61 * *	Five years.
GEORGE P. FRENCH, 1859, 60, 61, 62 and 63	Five years.
EBENEZER ATKINS, 1859 * *	One year.
GEORGE DENNIE, 1860, 61, 62, 63, 64 and 65	Six years.

CLEMENT WILLIS, 1860 **	One year.
G. E. PIERCE, 1860 **	One year.
JABEZ FREDERICK, 1861, 62 and 63 **	Three years.
GEORGE HINMAN, 1862 and 63	Two years.
JOHN F. PRAY, 1862	One year.
J. C. J. BROWN, 1862	One year.
JONAS FITCH, 1864, 65 and 66	Three years.
OTIS NORCROSS,* 1865 and 66	Two years.
L. MILES STANDISH, 1860, 61, 63, 64, 65, 66 and 67	Seven years.
JOHN H. THORNDIKE, 1864, 65, 66 and 67	Four years.
BENJAMIN F. STEVENS, 1866, 67 and 68	Three years.
WILLIAM S. HILLS, 1867	One year.
CHARLES R. TRAIN, 1868	One year.
JOSEPH M. WIGHTMAN, 1868 and 69	Two years.
BENJAMIN JAMES,* 1858, 68 and 69	Three years.
FRANCIS A. OSBORN, 1869	One year.
WALTER E. HAWES, 1870	One year.
JOHN O. POOR, 1870	One year.
HOLLIS R. GRAY, 1870	One year.
NATHANIEL J. BRADLEE, 1863, 64, 65, 66, 67, 68, 69, 70 and 71	Nine years.
GEORGE LEWIS, 1868, 69, 70 and 71	Four years.
SIDNEY SQUIRES, 1871	One year.
CHARLES H. HERSEY, 1872	One year.
CHARLES H. ALLEN, 1869, 70, 71 and 72	Four years.
ALEXANDER WADSWORTH,* 1864, 65, 66, 67, 68, 69 and 72	Seven years.
CHARLES R. M'LEAN, 1867, 73 and 74	Three years.
EDWARD P. WILBUR, 1873 and 74	Two years.
JNO. A. HAVEN, 1870, 71, 72, 73 and 74 **	Five years.
THOMAS GOGIN,* 1873, 74 and 75	Three years.
AMOS L. NOYES, 1871, 72 and 75	Three years.
WM. G. THACHER, 1873, 74 and 75	Three years.
CHARLES J. PRESCOTT, 1875	One year.
LEONARD R. CUTTER, 1871, 72, 73, 74 and 75	
L. MILES STANDISH, 1860, 61, 63, 64, 65, 66, 67, 74 and 75	} <i>Last Cochituate Water Board.†</i>
EDWARD A. WHITE, 1872, 73, 74 and 75	
CHARLES E. POWERS, 1875	
SOLOMON B. STEBBINS, 1876	
NAHUM M. MORRISON, 1876	
AUGUSTUS PARKER, 1876	

* Mr. John H. Wilkins resigned Nov. 15, 1854, and Charles Stoddard was elected to fill the vacancy. Mr. Henry B. Rogers resigned Oct. 22, 1865. Mr. Wilkins was re-elected Feb., 1856, and chosen President of the Board, which office he held until his resignation on June 5, 1860, when Mr. Ebenezer Johnson was elected President, and, on July 2, Mr. L. Miles Standish was elected to fill the vacancy occasioned by the resignation of Mr. Wilkins. Otis Norcross resigned Jan. 15, 1867, having been elected Mayor of the city. Benjamin James served one year, in 1858, and was re-elected in 1868. Alexander Wadsworth served six years, 1864-69, and was re-elected in 1872. Thomas Gogin resigned May 31, 1875. Charles E. Powers elected July 12, 1875, to fill the vacancy caused by the resignation of Mr. Gogin.

** Deceased.

† The BOSTON WATER BOARD assumed its duties July 31, 1876.

[From the Report of Mr. Alfred T. Turner, City Auditor.]

COST OF THE COCHITUATE WATER WORKS.

The following table shows the gross payments for constructing, carrying on and extending the Cochituate Water Works, from their commencement, August 20, 1846, to April 30, 1876, and the interest, discount and premium on the debt created for the purpose; also the income received from all sources to the credit of said works.

GROSS EXPENDITURES.

Water Commissioners' payments,	\$4,043,718 21
Water Board of 1850, payments,	366,163 89
Cochituate Water Board's requisitions to April 30, 1876,	10,586,138 83
Other payments, which include salaries paid to the Water Registrar, previous to 1866-67, Treasurer's Clerk for this department to 1875-76, executions against the city on account of the works, etc.,	99,369 60
Interest, discount and premium account,	11,736,113 95
Total Gross Expenditures,	<u>\$26,831,504 48</u>

GROSS INCOME.

From water-rates from 1848 to April 30, 1876,	\$12,613,000 68
From shutting off and letting on water for non-payment of rates, sales of old materials, and all other sources,	746,691 39
	<u>13,359,692 07</u>
NET COST of the Cochituate Water Works to the city, all income being deducted, April 30, 1876,	<u><u>\$13,471,812 41</u></u>

We have heretofore placed under the gross income of the Cochituate Water Works the amount of \$1,352,000, received in the Sinking Fund for the redemption of the City Debt from May 1, 1860, to May 1, 1871, being 3 per cent. on the outstanding loans each year, with compound interest, which was the period the fund was in charge of the Committee of the City Council on the reduction of the debt of the city, and no part of the amount collected was set apart for redeeming the indebtedness of the Water Works; but upon reflection the Auditor considers that it should not be used to show the difference between the actual cost of the works and the revenues earned therefrom. Said amount is applicable to the reduction of the water debt, and is in the hands of the Sinking Fund Commissioners for that purpose, and deducted from the amount before given leaves \$12,119,812.41 for the Cochituate Water Debt.

The following construction account table, prepared by the present

clerk of the Cochituate Water Board, Walter E. Swan, with the approval of the Auditor of Accounts, shows the actual cost of the works to April 30, 1876, and contains every item fairly chargeable to construction account, as nearly as can be ascertained.

This shows clearly that there has been a deficiency in the receipts to cover the running expenses of the works and interest on the cost of the works, since the water was supplied to the citizens, of \$1,477,232.63, as the \$1,352,000 above spoken of was raised by taxation and formed no part of the earnings of the works.

COST OF THE WORKS TO MAY 1, 1876.

Cost of Water Works to January 1, 1850, as per final report of Water Commissioners,	\$3,998,051 82
Extension to East Boston,	281,065 44
Jamaica-pond aqueduct,	45,237 50
New dam at Lake Cochituate,	10,940 08
Raising lake two feet, including damages,	28,002 18
Dudley pond, lower dam, and making connections with the lake,	18,982 23
New main from Brookline reservoir,	304,991 88
Land and water rights since January 1, 1850,	58,331 40
Land damages since January 1, 1850,	15,511 62
New pipe-yard and repair-shop,	25,666 51
Upper yard, buildings, etc.,	9,165 63
New water-pipes, East Boston,	20,999 43
New main, East Boston,	24,878 08
Water to Deer Island,	75,000 00
Pumping-works at Lake Cochituate,	15,000 00
High service, stand-pipe, engine-houses, and engines,	83,829 53
High service, South Boston,	27,860 29
Chestnut-Hill reservoir, including land,	2,449,982 07
Parker-Hill reservoir, " "	228,246 17
Charles-river siphon,	26,532 35
Additional supply of water, including land damages and all expenses,	1,186,254 56
Cost of main pipe, since January 1, 1850,	830,310 98
" laying main pipe since January 1, 1850,	454,233 70
" hydrants, stopcocks and boxes, and setting same,	251,376 63
" main pipe, for extension in Roxbury, Dorchester, Brighton and West Roxbury districts,	877,197 81
Cost of laying main pipe for extension in Roxbury, Dorchester, Brighton and West Roxbury districts,	358,429 04
Cost of hydrants, stopcocks and boxes, and setting same in above districts,	344,859 74
	<hr/>
	\$12,050,936 63
CR. By sale of Jamaica-pond aqueduct,	\$32,000 00
By sale of land to May 1, 1876,	24,356 85
	<hr/>
	56,356 85
	<hr/>
	<u>\$11,994,579 78</u>

HISTORY OF THE BOSTON WATER WORKS.

TABLE NO. I.

Annual Amount of Rainfall, in Inches, at Lake Cochituate, Boston and vicinity, 1849 to 1875, inclusive.

YEAR.	PLACES AND OBSERVERS.						
	Lake Cochituate, by Sup't of Western Division, E. W. W.	Boston, by J. P. Hall to 1865, by W. H. Bradley since 1865.	Cambridge, by the Director of the Observatory.	Waltham, by Agent Boston Manufacturing Company.	Lowell, by Merrimac Manufacturing Co.	Lowell, by Locks and Canals Company, J. B. Francis.	Providence, by A. Caswell.
1849 . . . . .	..	40.30	40.97	40.74	41.91	..	34.69
1850 . . . . .	..	53.98	54.07	62.13	51.09	..	51.49
1851 . . . . .	..	44.31	41.97	41.00	45.68	..	43.38
1852	*47.93	47.94	40.51	42.24	42.78	..	38.58
1853	*55.73	48.86	53.83	45.04	43.92	..	53.27
1854	43.15	45.71	45.17	41.29	42.08	..	46.25
1855	34.96	44.19	47.59	40.63	44.89	48.41	39.05
1856	40.80	52.16	53.79	42.33	42.49	45.97	40.97
1857	53.10	56.87	57.92	44.04	49.38	52.02	44.75
1858	48.66	52.67	45.46	37.40	37.73	35.80	44.51
1859	49.02	56.70	..	48.49	47.51	48.41	45.16
1860	55.44	51.46	46.95	45.97	46.91	46.67	38.44
1861	45.44	50.07	50.14	36.51	43.32	42.95	44.25
1862	49.69	61.06	57.21	46.42	44.26	44.61	50.14
1863	60.30	67.72	56.42	53.66	52.37	57.31	55.17
1864	42.60	49.30	39.46	36.56	38.11	40.64	36.83
1865	49.46	47.83	43.59	35.84	37.38	38.82	44.69
1866	62.32	50.70	..	43.46	38.18	41.36	46.02
1867	56.25	55.64	41.71	41.40	45.54	45.87	47.04
1868	49.71	64.11	39.39	44.65	47.96	49.58	53.52
1869	64.34	66.28	47.98	47.30	47.30	48.96	47.70
1870	55.89	59.73	41.53	39.40	46.30	48.71	49.02
1871	45.39	48.33	40.56	36.82	44.45	44.17	47.91
1872	48.47	58.04	52.73	45.80	44.32	48.67	48.71
1873	45.43	54.94	46.81	42.58	39.86	45.05	52.56
1874	35.93	41.09	38.73	32.32	35.68	41.76	43.39
1875	45.49	51.01	51.00	40.30	40.29	43.63	52.22

* By J. Vannevar.

TABLE NO. II.
Table of the average monthly and yearly heights of water in the Lake above the bottom of the Aqueduct.

MONTH.	1864.	1865.	1866.	1867.	1868.	1869.*	1870.	1871.	1872.	1873.	1874.	1875.										
January	10.54	10.16	8.06	9.53	10.75	10.80	10.83	11.93	6.09	11.33	13.88	6.41	8.37	12.14	10.29	12.27	13.25	5.29	4.23	12.53	11.54	0.52
February	10.95	10.65	7.59	10.28	10.05	12.17	11.36	12.77	6.57	12.85	13.71	8.24	8.73	13.14	9.75	12.96	13.19	5.40	2.52	12.31	12.71	0.92
March	10.93	10.68	6.96	10.67	9.35	12.45	12.67	13.21	8.66	13.95	14.33	12.28	10.88	13.57	10.96	13.21	12.51	7.96	1.19	12.06	12.98	6.83
April	10.66	11.57	10.24	12.30	9.36	12.06	12.72	14.14	12.40	14.59	14.32	14.00	11.96	13.50	13.29	13.40	13.33	9.31	4.19	13.17	13.12	11.83
May	10.87	11.35	12.05	12.05	10.67	12.06	11.52	13.88	14.45	14.01	14.26	14.00	12.01	13.44	13.67	13.65	13.12	10.37	5.10	13.17	13.33	13.00
June	10.33	10.69	11.78	12.14	11.72	11.96	10.83	12.99	14.43	13.29	13.51	13.41	12.72	13.20	13.37	13.23	13.02	9.27	5.79	12.04	13.29	13.08
July	9.00	9.86	10.67	11.41	11.74	10.22	10.42	11.50	14.05	12.62	11.33	12.28	11.84	12.12	12.46	12.62	12.12	7.83	6.33	10.25	12.25	12.50
August	6.67	9.01	11.59	11.70	11.30	10.24	9.42	10.27	12.97	13.73	9.66	11.18	11.79	12.17	11.70	11.04	10.37	6.27	7.04	8.87	10.94	12.67
September	6.64	7.52	10.82	11.72	10.40	9.84	9.42	8.71	11.33	13.43	7.91	10.09	11.59	12.00	11.61	9.73	8.67	5.00	10.02	7.60	9.37	11.25
October	5.90	6.42	10.10	11.10	8.72	10.15	10.35	7.79	10.30	12.94	6.46	9.02	11.72	11.10	11.83	10.58	8.10	3.81	11.46	7.29	7.50	10.31
November	6.09	6.28	10.80	11.16	9.01	9.98	10.44	7.22	10.24	13.26	5.48	8.74	11.41	11.03	11.76	11.21	7.10	3.60	12.67	7.60	5.42	9.87
December	8.38	7.29	10.97	11.02	9.85	10.54	11.17	6.88	11.70	14.06	5.41	8.48	11.68	10.51	12.33	11.77	6.40	3.83	12.40	9.08	3.60	9.67
Yearly average .	9.00	9.29	10.14	11.26	10.24	11.04	11.93	10.94	11.10	13.52	10.84	10.76	11.20	12.33	11.92	12.15	10.96	6.50	6.91	10.50	10.50	9.37

* High-water mark raised two feet.

TABLE NO. III.

Statement showing amount of Rainfall on Water-shed of Lake Cochituate, amount of Water consumed and wasted, available amount received into Lake, available percentage of Rainfall, etc., from 1852 to 1875, inclusive. Water-shed of Lake = 12,077 acres.

YEAR.	Rainfall.	Amount of rain-fall on Water-shed of Lake Cochituate.	Amount of Water drawn from Lake.	Amount of Water wasted from Lake.	Total amount consumed and wasted.	Rise of Lake during the year.	Fall of Lake during the year.	Total amount of Rainfall received into Lake.	Daily average amt of rain-fall received into Lake.	Percentage of Rainfall rec'd into Lake.
	Inches.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.	
1852*	47.93	15,759,207,000	2,974,042,800	4,020,566,885	6,994,609,685	. . . . .	261,360,000	6,735,249,685	18,896,867	43 per cent.
1853	55.78	18,866,561,000	3,117,939,500	3,166,417,500	6,284,357,000	239,680,000	. . . . .	6,523,937,000	17,873,800	35 per cent.
1854	43.15	14,187,562,000	3,614,230,000	4,187,733,020	7,801,963,020	. . . . .	217,800,000	7,584,163,020	20,778,629	53 per cent.
1855	34.06	11,494,719,000	3,776,399,500	No acc't kept.	. . . . .	. . . . .	326,700,000	. . . . .	. . . . .	. . . . .
1856	40.80	13,414,892,000	4,409,787,600	No acc't kept.	. . . . .	598,950,000	. . . . .	. . . . .	. . . . .	. . . . .
1857	63.10	20,747,032,000	4,644,990,000	10,625,900,000	15,270,890,000	32,670,000	. . . . .	15,303,560,000	41,927,692	74 per cent.
1858	48.66	15,999,222,000	4,689,155,000	1,934,500,000	6,623,655,000	. . . . .	141,570,000	6,482,085,000	17,759,018	40 per cent.
1859†	49.02	16,117,692,000	4,808,875,000	7,569,000,000	12,377,875,000	283,140,000	. . . . .	12,661,015,000	34,687,712	78 per cent.
1860	55.44	18,223,471,000	6,309,108,000	None.	6,309,108,000	174,240,000	. . . . .	6,483,348,000	17,714,065	33 per cent.
1861	45.44	15,269,303,000	6,639,095,900	3,377,543,966	10,016,639,866	. . . . .	1,459,260,000	8,567,594,866	23,444,917	56 per cent.
1862	49.69	16,337,890,000	6,069,000,000	33,200,000	6,092,200,000	1,806,800,000	. . . . .	7,899,000,000	20,271,233	45 per cent.
1863	69.30	22,735,586,000	5,927,052,600	2,165,698,470	8,092,751,070	762,800,000	. . . . .	8,855,048,970	24,260,408	39 per cent.
1864	42.60	14,009,726,000	6,105,306,700	1,368,746,000	7,474,052,700	. . . . .	1,848,577,000	5,625,475,700	16,370,152	40 per cent.
1865	49.46	16,262,266,000	4,621,630,000	1,688,120,674	6,309,750,674	743,242,600	. . . . .	7,052,993,174	19,823,270	43 per cent.
1866	62.32	20,490,445,000	4,463,585,000	None.	4,463,585,000	743,242,600	. . . . .	5,209,827,600	14,265,280	29 per cent.
1867	56.25	18,494,705,000	4,951,225,000	2,492,041,000	7,433,266,000	. . . . .	698,811,000	6,734,455,000	18,450,600	30 per cent.

TABLE NO. IV.

Distances between Different Points of the Water Works.

From the Gate-House at the Lake to the Waste Weir at Dedham's Brook. — Sect. 3	15,870 feet.
Thence, to the Waste Weir, in Sect. 6	19,011 “
Thence, to the Pipe Chamber, West side of Charles River	6,167 “
Thence, across Charles River, to East Pipe Chamber	1,095 “
Thence, to the Waste Weir, in Sect. 10	15,025 “
Thence, through Newton Tunnel, 2,410 feet to the Ventilator	7,308 “
Thence, to the Waste Weir, in Sect. 13	8,650 “
Thence, through Brookline Tunnel, 1,150 feet, to Brookline Reservoir	4,103 “
Thence, to the Gate-House, at the east end of the Reservoir	2,000 “
Thence, to Dover street	19,625 “
Thence, to the Fountain on the Common	4,073 “
Thence, to Beacon-Hill Reservoir	1,200 “
Thence, to East-Boston Reservoir	20,129 “
From Dover street to South-Boston Reservoir	8,570 “
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From the Lake to east end of Brookline Reservoir	15.005 miles.
From Brookline Reservoir to Fountain on the Common	4.488 “
From Brookline Reservoir to Beacon-Hill Reservoir	5.094 “
From Brookline Reservoir to East-Boston Reservoir	8.528 “
From Brookline Reservoir to South-Boston Reservoir	5.350 “
From the Gate-House at the Lake to the Chestnut-Hill Reservoir, Lower Gate House	13.596 “
From the Chestnut-Hill Reservoir Gate-House to the Brookline Gate-House, in an air line	1.182 “

TABLE NO. V.

Heights of Important Points above Tide-Marsh Level.

Floor of Knight's Flume	124.36 feet.
Low-Water Mark, Lake Cochituate	124.86 "
High " " " "	134.36 "
Bottom of interior of Aqueduct, at Lake Cochituate .	121.00 "
" " " West Pipe Chamber	119.04 "
" " " East " "	118.52 "
" " " Brookline Reservoir	116.77 "
" Brookline Reservoir	100.60 "
Upper floor of Brookline Gate-House	126.76 "
Low-Water Mark, Brookline Reservoir ,	120.60 "
Top of Dam of " "	126.60 "
Bottom of Beacon-Hill Reservoir	108.03 "
Top " " " Coping (outside) .	124.03 "
Bottom " " " Waste Weir . .	121.53 "
" South Boston "	105.35 "
Top " " " Dam	125.86 "
Bottom of East Boston "	80.60 "
Top " " " Dam	110.60 "
State House Floor	106.94 "
Coping of Charlestown Dry Dock	5.09 "
Gate-House Floor, at Lake	138.10 "
Bottom of interior of Aqueduct, at the Intermediate Gate- House, Chestnut-Hill Reservoir	117.17 "
Top of Dam, at Chestnut-Hill Reservoir	128.00 "
High-Water Mark, " " "	125.00 "
Lower Floor of Intermediate Gate-House, C. H. R. .	110.00 "
Upper " " " " " . .	128.42 "
Lower " Effluent " " " . .	99.00 "
Upper " " " " " . .	128.32 "
Interior Bottom at Pipe, at Effluent Gate-House, C. H. R.	100.00 "

TABLE NO. VI.
Statement of the Length of different Sizes of Pipes laid, and the Number of Stopcocks put in, to May 1, 1876.

DIAMETER OF PIPES IN INCHES.															Aggregate.
	48	40	36	30	24	20	16	12	10	9	8	6	4	3	
Feet of Pipe laid in Brookline, } Boston Highlands and Boston } Proper	7,283	23,166	20,070	26,770	6,773	5,823	20,069	111,161	...	635	32,177	310,603	94,180	...	1,689,911 feet, equal to 320 miles 311 feet.
Number of Stopcocks in same	6	6	8	11	11	5	44	238	...	...	98	798	404	...	8,439
Feet of Pipe laid in Boston Highlands . . . . .	...	...	185	106	11,427	5,801	10,825	83,367	...	...	5,626	148,351	27,977	288	
Number of Stopcocks in same . . . . .	...	...	1	2	9	1	18	122	...	...	11	317	119	2	
Feet of Pipe laid in South Boston . . . . .	...	...	...	...	...	13,206	...	47,444	...	105	5,156	126,027	86,828	...	
Number of Stopcocks in same . . . . .	...	...	...	...	...	6	...	74	9,923	...	9	238	109	...	
Feet of Pipe laid in East Boston . . . . .	...	...	...	...	1,463	16,972	2,152	36,533	...	218	23,074	83,657	6,094	...	
Number of Stopcocks in same . . . . .	...	...	...	...	8	6	6	45	3	...	15	149	61	...	
Feet of Pipe laid in Dorchester . . . . .	...	...	...	...	7,784	3,698	456	91,030	...	1,340	10,441	91,984	3,977	...	
Number of Stopcocks in same . . . . .	...	...	...	...	6	1	1	107	...	...	16	182	25	...	
Feet of Pipe laid in West Roxbury . . . . .	...	...	...	...	...	...	2,916	24,226	...	...	12,216	16,164	417	...	
Number of Stopcocks in same . . . . .	...	...	...	...	...	...	1	31	...	...	18	30	7	...	
Feet of Pipe laid in Brighton . . . . .	...	...	...	...	...	...	8,968	27,436	...	...	13,139	8,927	65	...	
Number of Stopcocks in same . . . . .	...	...	...	...	...	...	6	37	...	...	17	17	2	...	
Feet of Pipe laid in Newton and } Needham . . . . .	...	1,435	1,074	2,140	...	...	...	1,489	...	...	...	300	...	...
Number of Stopcocks in same . . . . .	...	...	...	...	...	...	...	3	...	...	...	2	...	...
Totals — Length of Pipe laid	7,283	24,601	21,329	26,019	26,447	44,500	45,386	452,718	9,923	3,234	101,832	783,913	169,488	288	
Number of Stopcocks put in	6	6	9	13	25	20	74	652	3	...	184	1,728	717	2	

THBLE NO. VII.

Statement of Number of Leaks, 1850-1875.

YEAR.	DIAMETER OF.		TOTALS.
	Four inches and upwards.	Less than Four inches.	
1850	32	72	104
1851	64	173	237
1852	82	241	323
1853	85	260	345
1854	74	280	354
1855	75	219	294
1856	75	282	307
1857	85	278	363
1858	77	324	401
1859	82	449	531
1860	134	458	592
1861	109	399	508
1862	117	373	490
1863	97	397	494
1864	95	394	489
1865	111	496	607
1866	139	536	675
1867	123	487	609
1868	82	449	531
1869	82	407	489
1870	157	769	926
1871	186	1,380	1,566
1872	188	1,459	1,647
1873	153	1,076	1,229
1874	434	2,120	2,554
1875	203	725	928

TABLE NO. VIII.

Statement showing the number and kind of Water Fixtures contained within the premises of Water-takers in the City of Boston to January 1, 1876, as compared with previous years.

1873.	1874.	1875.	REMARKS.
6,768	7,266	7,271	Taps. These have no connection with any drain or sewer.
67,089	72,310	72,897	Sinks.
32,690	36,141	37,611	Wash-hand basins.
11,580	12,040	12,725	Bathing-tubs.
16,222	18,877	20,575	Pan water-closets.
17,081	18,765	2,584	Hopper water-closets.
	201	17,569	" " automatic.
248	291		" " pull.
223	188		" " self-acting.
589	606	564	" " waste.
590	648		" " door.
2,445	2,851	1,636	Urinals.
	459	1,693	" automatic.
12,779	14,300	15,055	Wash-tubs. These are permanently attached to the building.
734	680	633	Shower-baths.
419	363	330	Private hydrants.
712	764	805	Slop-hoppers.
112	134	113	Foot-baths.
170,281	186,874	192,061	

TABLE NO. IX.

Statement showing the number of houses, stores, steam-engines, etc., in the City of Boston, supplied with water to the 1st of January, 1876, with the amount of water-rates paid for 1875 : —

30,056 Dwelling-houses	\$480,234 00
46 Boarding-houses	2,112 66
1,021 Model-houses	29,588 13
12 Lodging-houses	389 67
15 Hotels	1,119 00
5,856 Stores and shops	62,905 24
449 Buildings	21,554 66
696 Offices	5,973 56
45 Printing-offices	944 92
37 Banks	584 72
28 Halls	514 50
1 Museum	45 50
30 Private schools	590 67
17 Asylums	1,118 00
4 Hospitals	249 50
48 Greenhouses	1,144 33
113 Churches	1,808 00
7 Markets	1,187 50
94 Cellars	657 50
831 Restaurants and saloons	18,083 60
14 Club-houses	307 84
36 Photographers	1,077 37
33 Packing-houses	1,327 83
1,647 Stables	13,087 74
41 Factories	1,436 62
5 Bleacheries	117 50
1 Brewery	105 00
3 Beer factories	172 50
112 Bakeries	1,261 75
1 Boat-house	49 00
10 Freight-houses	242 50
4 Gasometers	54 00
3 Ship-yards	51 00
1 College	40 00
1 Mill	50 00

1 Cemetery	\$10 00
1 Bath-house	10 42
63 Shops and engines	3,222 76
49 Stores and engines	4,229 29
18 Factories and engines	1,111 25
1 Foundry and engine	92 50
6 Printing and engines	745 38
3 Bakeries and engines	124 00
3 Ship-yards and engines	81 25
1 Dry dock and engine	34 00
11 Buildings and engines	983 00
24 Stationery engines	1,667 43
78 Discharging and pile-driving engines	914 00
15 Armories	249 92
741 Hand hose	5,070 00
16 Fountains	237 00
58 Tumbler-washers	870 00
52 Water-pressures	260 00
15 Laundries	288 54
2 Commercial colleges	99 00
1 Laboratory	50 00
1 Milk company	55 00
Custom House	85 00
Branch post-offices	88 00
11 Aquariums	135 00
Filling gasometers	178 26
Filling cisterns	8 50
1 Ice company, (washing ice)	30 00
1 Gymnasium	50 00
1 Depot	36 00
7 Railroad stations	92 92
67 Steamboats	11,979 62
Office (City Scales)	11 00
Lockup, Ward 24	6 00
District court-houses	67 50
Probate building	75 00
House of Reception	10 00
44 Fire engines, hose and hook-and-ladder houses	940 00
3,197 Fire hydrants	57,546 00
98 Reservoirs	1,764 00
Fire-boat "William M. Flanders"	200 00
385 Public schools	3,364 00

APPENDIX.

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City Stables	\$226 25
Washing-carts	125 00
Offal station	225 00
Faneuil Hall	40 00
Public Library	50 00
Branch Libraries	43 50
Paving Department	327 75
Common Sewer Department	250 0
Lamp Department	17 25
Public urinals	170 00
Street sprinkling	500 00
Street watering	73 05
Drinking fountains	455 00
Steamer "Samuel Little"	100 00
Small-pox Hospital	25 00
Building purposes	2,440 27
Metered water (9 months)	192,355 02
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	\$944,680 94

TABLE NO. X.

Total number of HYDRANTS up to May 1, 1876:—

Boston proper	1,272
South Boston	467
East Boston	283
Boston Highlands	745
Dorchester	577
Brookline	9
West Roxbury	134
Brighton	131
Charlestown	11
Chelsea	8
Deer Island	16
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Total	3,653

TABLE NO. XI.
Consumption of Water.

MONTH.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.
January	1,700,000	6,181,700	7,233,700	8,280,900	8,060,500	10,695,200	9,702,700	12,669,000	15,089,000	12,160,000	14,512,000	17,962,000	21,108,769
February . . . . .	. . . . .	5,214,000	7,221,100	8,790,300	8,643,600	10,654,200	10,349,800	11,791,000	14,176,000	14,399,000	14,769,000	19,901,000	20,804,131
March	1,650,000	4,841,200	6,137,900	8,621,100	8,202,200	9,682,100	10,128,600	12,604,000	13,941,000	14,164,000	14,480,000	16,409,000	19,453,844
April . . . . .	. . . . .	4,961,000	5,385,200	8,048,700	7,903,600	8,738,500	8,640,000	10,800,000	12,464,000	13,465,000	13,760,000	14,621,000	17,151,593
May	3,600,000	5,846,100	6,238,400	8,260,000	8,128,400	9,686,300	9,103,800	10,275,000	12,414,000	11,423,000	11,802,000	14,790,000	16,687,582
June	4,300,000	6,906,500	7,926,000	8,633,100	8,946,900	11,745,200	9,984,400	11,223,000	12,604,000	10,367,000	11,689,000	17,338,000	17,231,984
July	4,800,000	8,514,200	7,180,200	9,408,000	8,809,200	10,813,900	11,066,600	13,167,000	13,681,000	13,621,000	13,219,000	17,239,000	18,897,809
August	4,100,000	8,004,600	7,285,000	9,709,300	8,461,900	10,023,100	11,120,800	12,664,000	13,677,000	13,141,000	12,704,000	19,297,000	18,272,866
September	4,800,000	6,685,500	7,280,600	7,920,000	8,640,700	9,712,400	11,710,800	11,622,000	12,080,000	12,746,000	12,399,000	17,957,000	18,008,249
October	4,550,000	4,604,300	1,716,600	6,680,000	8,876,100	8,769,800	10,771,260	11,891,000	10,864,000	12,909,000	12,026,000	16,938,000	17,987,123
November	3,800,000	4,960,500	6,473,500	6,637,000	8,624,700	8,080,300	10,383,200	11,691,000	11,392,000	12,143,000	12,716,000	16,892,000	16,604,076
December	3,600,000	5,037,000	7,663,400	7,195,800	9,228,400	10,697,900	11,807,200	13,284,000	11,241,000	13,075,000	14,586,000	19,151,000	16,976,862
Average for year . . .	3,690,000	5,537,900	6,888,800	8,125,800	8,642,300	9,902,000	10,346,300	12,046,600	12,726,000	12,847,000	13,176,000	17,283,000	18,189,304

Consumption of Water.

MONTH.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1870.	1871.	1872.	1873.	1874.	1876.
January . . .	17,000,000	16,112,000	18,964,000	13,412,000	14,860,000	13,611,000	15,992,000	16,426,000	12,625,000	14,110,000	12,203,900	17,639,100	16,651,300	19,075,300
February . . .	17,000,000	17,828,000	18,846,000	13,318,000	13,385,000	13,881,000	16,927,000	14,731,000	14,652,000	16,070,000	15,172,000	18,461,000	19,103,850	20,991,700
March	17,300,000	16,681,000	16,841,000	12,027,000	12,284,000	13,100,000	13,722,000	14,789,000	14,646,000	10,162,000	15,788,500	15,983,700	17,657,300	17,873,100
April	16,300,000	16,125,000	16,606,000	11,975,000	11,261,000	12,770,000	12,636,000	14,650,000	14,703,000	11,814,000	12,281,000	14,781,300	16,928,600	16,852,000
May	14,300,000	16,407,000	16,994,000	13,660,000	11,076,000	12,301,000	13,846,000	13,902,000	13,769,000	12,222,000	13,880,608	17,637,400	16,731,900	17,164,500
June	16,600,000	16,138,000	17,730,000	14,391,000	11,878,000	13,625,000	14,361,000	14,232,000	14,824,000	15,695,000	14,617,600	20,100,600	19,239,750	19,928,400
July	16,400,000	16,954,000	18,112,000	13,207,000	12,668,000	14,260,000	14,676,000	18,378,000	16,392,000	16,748,000	16,377,100	20,917,100	21,386,200	20,386,400
August	17,000,000	16,980,000	16,185,000	13,426,000	12,441,000	14,646,000	14,479,000	17,632,000	17,107,000	16,019,000	15,017,900	19,644,600	20,127,800	19,083,200 *
September . .	17,000,000	17,035,000	16,798,000	12,624,000	11,842,000	13,186,000	16,072,000	16,741,000	16,785,000	16,612,000	15,072,600	19,572,700	20,022,600	20,497,400
October	17,300,000	16,779,000	16,479,000	11,273,000	12,396,000	13,618,000	14,964,000	14,096,000	16,628,000	13,856,000	15,644,800	17,113,800	19,320,900	19,470,700
November . .	17,100,000	16,028,000	14,079,000	11,760,000	11,292,000	12,707,000	13,975,000	13,608,000	14,677,000	13,674,000	17,591,400	16,633,400	14,319,500	19,076,400
December . . .	17,000,000	16,296,000	14,647,000	10,877,000	11,412,000	16,434,000	15,600,000	13,640,000	14,094,000	12,664,000	17,283,700	16,727,100	16,407,950	21,396,500
Average for year.	16,600,000	15,238,500	16,681,000	12,662,000	12,229,000	13,666,000	14,796,167	15,070,400	15,007,700	13,945,500	15,083,400	17,842,700	14,074,900	19,267,700

TABLE NO. XII.

The following table exhibits the yearly revenue from the sale of Cochituate water since its introduction into the city, October 25th, 1848 : —

Received by Water Commissioners, as per Auditor's Report,						
in 1848,	.	.	.	.	.	\$972 81
From January 1, 1849, to January 1, 1850,	.	.	.	.	.	71,657 79
" " 1850,	"	1851,	.	.	.	99,025 45
" " 1851,	"	1852,	.	.	.	161,052 85
" " 1852,	"	1853,	.	.	.	179,567 39
" " 1853,	"	1854,	.	.	.	196,352 32
" " 1854,	"	1855,	.	.	.	217,007 51
" " 1855,	"	1856,	.	.	.	266,302 77
" " 1856,	"	1857,	.	.	.	282,651 84
" " 1857,	"	1858,	.	.	.	289,328 83
" " 1858,	"	1859,	.	.	.	302,409 73
" " 1859,	"	1860,	.	.	.	314,808 97
" " 1860,	"	1861,	.	.	.	334,544 86
" " 1861,	"	1862,	.	.	.	365,323 96
" " 1862,	"	1863,	.	.	.	373,922 33
" " 1863,	"	1864,	.	.	.	394,506 25
" " 1864,	"	1865,	.	.	.	430,710 76
" " 1865,	"	1866,	.	.	.	450,341 48
" " 1866,	"	1867,	.	.	.	486,538 25
" " 1867,	"	1868,	.	.	.	522,130 93
" " 1868,	"	1869,	.	.	.	553,744 88
" " 1869,	"	1870,	.	.	.	597,328 55
" " 1870,	"	1871,	.	.	.	708,783 68
" " 1871,	"	1872,	.	.	.	774,445 70
" " 1872,	"	1873,	.	.	.	806,102 51
" " 1873,	"	1874,	.	.	.	859,436 55
" " 1874,	"	1875,	.	.	.	914,748 73
" " 1875,	"	1876,	.	.	.	944,680 94
" " 1876, to May 1,		1876,	.	.	.	717,698 93
						<hr/>
						\$12,616,127 55

TABLE NO. XIII.

*Cochituate Water Rates.**DWELLING-HOUSES.*

SECT. 27. The following rates shall be charged annually for the use of the Cochituate water :—

Every dwelling-house, including the land under, and used in connection with, the same, shall be charged, when they are valued for the assessment of taxes at \$1,000, or any less sum, and occupied by one family only, *six dollars*; and for every additional \$1,000, or fractional part thereof, *one dollar*, until the valuation for the assessment of taxes shall amount to \$25,000; and for every family more than one in a dwelling-house, the charge shall be for each *two dollars*.

In addition to the foregoing rates, there shall be charged to each dwelling-house with one family from one dollar to ten dollars for each water-closet and each bath-tub in use, according to the amount of water used; and for each family, more than one, the annual charge shall be, for each, two dollars additional.

TENEMENT-HOUSES.

SECT. 28. For the use of Cochituate water in model or tenement houses, which are rented in suits of rooms to different families, the rate of charge for each such tenement shall be based upon the rental of such tenement, viz. : Every tenement occupied, and having a faucet within the same, shall be charged *three dollars* annually, and *fifty cents* additional on every one hundred dollars, or fraction of one hundred dollars rent above three hundred dollars; *provided*, that the said rate may be based upon the estimated yearly rentable value of each such tenement.

In addition to the foregoing rate, there shall be charged to each tenement from one to ten dollars for each water-closet and each bath-tub in use, according to the amount of water used.

Each tenement in which there are no water-fixtures, the occupants taking the water from taps in common with other tenants of the house, shall be charged *two dollars* annually; and an additional charge of *two dollars* annually shall be made to each tenement the occupants of which use a water-closet in common with other tenants.

BUILDINGS.

SECT. 29. The following rates shall be charged for the use of Cochituate water in buildings occupied for offices, or by different tenants for business purposes, viz. : For each office or tenement having a faucet within the same, *three dollars* annually ; and for each office or tenement not having water within the same, but taking it from faucets in common with other tenants, *two dollars* annually.

And in addition to these rates there shall be charged for each water-closet in use, within the office or tenement, from one to ten dollars, according to the amount of water used ; and when the water-closet is located so as to be used in common, the charge for each office or tenement shall be from one to ten dollars, according to the amount of water used.

HOTELS AND BOARDING-HOUSES.

SECT. 30. Hotels, taverns and boarding-houses (said boarding-houses being valued for the assessment of taxes over \$15,000), not including water for baths or for uses without the house, shall be charged, for each bed for boarders and lodgers within the same, *three dollars* ; *provided*, that in no case shall any hotel, tavern or boarding-house be charged less than if occupied as a private dwelling-house.

STORES AND SHOPS.

SECT. 31. Each tenement occupied as a store, warehouse, office, shop, or for purposes not included in any other classification, and not requiring more than an ordinary supply of water, shall be charged from *six to twenty-five dollars*. For each water-closet more than one, supplied for the above, there shall be charged *five dollars* additional. And for each urinal, wash-hand basin or sink, more than one, *two dollars and fifty cents* additional.

STABLES.

SECT. 32. Private stables, including water for washing carriages, shall be charged *six dollars* ; and for each horse over two, the charge shall be *two dollars*. Livery stables, including water for washing carriages, shall be charged, for each horse, *two dollars*. Omnibus stables shall be charged for each horse, *one dollar and fifty cents*. Truckman's stables shall be charged, for each horse, *one dollar and twenty-five cents* ; *provided*, that in no case shall any stable be charged less than *five dollars*.

HOSE.

SECT. 33. There shall be charged for the right to attach a hose, of not more than five-eighths of an inch orifice, for washing windows or sprinkling streets, in addition to the charge for other uses, from *five to fifty dollars*, according to the amount of water used. But no hose shall be attached or used in any stable for washing horses or carriages, or for any other purpose whatever, except for extinguishing fires.

The following scale of prices for the use of hose has been adopted by the Water Board : —

For premises containing not over 5,000 square feet of land	.	\$5 00
Corner-lots containing not over 5,000 feet of land	.	10 00
Premises containing between 5,000 and 10,000 feet of land	.	10 00
“ “ “ 10,000 “ 20,000 “ “	.	20 00
“ “ “ 20,000 “ 30,000 “ “	.	30 00
“ “ “ 30,000 “ 40,000 “ “	.	40 00
“ “ “ 40,000 “ 50,000 “ “	.	50 00
“ “ over 50,000 feet of land will be charged special rates.		

EATING-HOUSES.

SECT. 34. Refectories, confectionaries, eating-houses, market and fish stalls, provision shops, refreshment and oyster saloons, according to the quantity of water used, shall be charged from *eight to fifty dollars*.

BATHS.

SECT. 35. Public baths shall be charged for each tub *five dollars*.

PRINTING-HOUSES.

SECT. 36. Every printing-office, according to the number of presses used, not including the supplying of a steam-engine, shall be charged from *six dollars to forty dollars*.

STEAM-ENGINES.

SECT. 37. Stationary steam-engines, working not over twelve hours a day, shall be charged by the horse-power, as follows : For each horse-power up to and not exceeding ten, the sum of *ten dollars*; for each exceeding ten, and not over fifteen, the sum of *eight dollars*; for each horse-power over fifteen the sum of *six dollars*.

STEAMBOATS.

SECT. 38. Steamboats shall be charged, for estimated quantities of water used for boiler and other purposes, at the rate of *six cents per one hundred gallons*; *provided*, however, that, in cases where meters are applied, the charge shall be *three cents per one hundred gallons*.

BUILDING PURPOSES.

SECT. 39. For building purposes there shall be charged for the water used with each cask of lime or cement, *seven cents*.

FOUNTAINS.

SECT. 40. Fountains are to be supplied with water at the discretion of the Cochituate Water Board; and the charge shall be upon the estimated quantity used, namely, for each one hundred gallons daily consumption, *five dollars per annum*.

BAKERIES.

SECT. 41. Bakeries shall be charged according to the average daily use of flour, namely for each barrel per day, the sum of *three dollars per annum*; *provided*, that in no case shall any bakery be charged less than *six dollars*.

MANUFACTORIES.

SECT. 42. Manufacturers and other persons, supplied with water through meters or by estimated quantity, shall be charged at the rate of *three cents per one hundred gallons*.

SECT. 43. When water is required for purposes which are not specified in the foregoing tariff, the rate shall be fixed by the Cochituate Water Board.

SECT. 44. Whenever two or more dwelling-houses, or other estates, are valued together for the assessment of taxes, the Water Registrar, under the direction of the Cochituate Water Board, shall make a separate valuation of the same; and whenever a portion only of any estate is justly chargeable for any water rate, the Water Registrar shall make a proper valuation of the said portion; and the water-rates hereinbefore provided shall apply to such valuations respectively.

SECT. 45. The Cochituate Water Board shall have power to ascertain by meters the quantity of water used in any case; and the proprietors or occupants of hotels, taverns, boarding-houses, or any other establishment using large quantities of water, shall also have authority to place within their premises, at their own expense, a sufficient water-meter, to be ap-

proved by the Water Registrar, for the purpose of measuring the quantity of water by them respectively used. The charge for the use of water by meter shall be *three cents for one hundred gallons*, to be collected quarterly by the Water Registrar; and all such bills shall be paid within ten days thereafter, or the Water Registrar shall cut off the supply after sending a summons as provided in section fifteen.

SECT. 15. In all cases of non-payment of the water-rent for sixty days after the same is due, the Water Registrar shall serve a summons at the premises of such delinquent; and unless said rent is paid within three days thereafter, together with twenty-five cents for said summons, the Water Registrar shall cut off the supply; and the water shall not be let on until the amount due, together with the twenty-five cents for said summons, and two dollars for the shutting off and letting on, is paid; *provided*, that no occupant shall be required to pay the amount due from a former occupant; and *provided, also*, that in cases of specific supplies, or when the water has been let on for fractional parts of the year, the summons may be served, and the water cut off immediately; and it shall not be let on again except upon the conditions before mentioned. The foregoing provisions shall apply when two or more parties take water through the same service-pipes, although one or more may have paid the proportion due from him or them.

SECT. 16. The Water Registrar, under the control of the Cochituate Water Board, may make abatements in the water-rents, in all proper cases.

SECT. 26. No hose shall be attached or used in any stable for washing horses or carriages, or for any other purposes whatsoever, except for extinguishing fires, under a penalty of ten dollars for each offence; and, if this penalty is incurred and is not paid within two days after demand for the same made at such stable, the water shall be cut off from such stable, and shall not be let on again until said penalty shall be paid and also the additional sum of two dollars for cutting off and letting on the water.

NOTE. — By a vote of the Board passed Nov. 11, 1874, the Water Registrar was directed to charge for all plain hopper-closets \$10.00 each, unless operated by self-closing faucets, in which case the charge to remain at the old tariff; and for all urinals \$5.00, unless operated by self-closing faucets.

TABLE NO. XIV.

Index to City Documents Relating to Water, 1834-1876.

- 1834, Doc. 12 (Com. Council), Report of Loammi Baldwin, Engineer, on the subject of introducing pure water into the city.
- 1836, Doc. 7 (Com. Council), Report on introducing water into the city; Doc. 10 (Com. Council), Report of R. H. Eddy, Engineer, on the introduction of soft water.
- 1837, Doc. 1 (Com. Council), Report on the introduction of water, with an order; Doc. 9 (Com. Council), Providing funds to cover the expense of introducing water; Doc. 24 (Com. Council), Report of Daniel Treadwell, J. F. Baldwin and Nathan Hale, on a plan for supplying the city with water.
- 1838, Doc. 1, Order under which the Water Commissioners were appointed; Doc. 4, Report on the introduction of water, accompanied by the opinion of the City Solicitor; Doc. 9, Communications from R. H. Eddy and L. M. Sargent, with evidence, etc., before the House of Commons, relative to the introduction of water into London; Doc. 11, Resolve pertaining to the Boston Hydraulic Co., and plan to supply the city with water; Doc. 33, Report on the introduction of water, with revised estimates of the Commissioners.
- 1839, Doc. 5, Report of J. F. Baldwin, giving reasons for dissenting from the opinion of the other Commissioners; Doc. 19, Report on the introduction of water; Doc. 25, Report on the introduction of water; Doc. 29, Statement of the evidence before the Legislature.
- 1843, Doc. 6, Report on petition of James C. Odiorne, for leave to bring into the city and distribute the water of Spot Pond.
- 1844, Doc. 24, Report of Commissioners on the expense of bringing water from Long Pond; Doc. 24½, Report of Commissioners on an order to devise a plan for supplying the city with; Doc. 25, Report of Joint Special Committee on the introduction of; Doc. 26, Report of same Committee, with resolve and order.
- 1845, Doc. 12½, Proceedings before Committee of the Legislature, on the petition of the city for leave to introduce water from Long Pond; Doc. 27, Petition of Stockholders of Spot Pond Aqueduct Co.; Doc. 29, Report on a petition concerning a subscription on the part of the city to the capital of the Spot Pond Aqueduct Co.; Doc. 40, Report on the proposition to sell Spot Pond to the city; Doc. 41, Report of the Commissioners on the sources from which a supply may be obtained.
- 1846, Doc. 14½, An ordinance to regulate the proceedings of the Commissioners for supplying the city with; Doc. 20, First monthly report of Commissioners; Doc. 21, Report on arrangements necessary to procure funds to pay for the introduction of; Doc. 26, First quarterly report of Standing Committee on; Doc. 32, Report of Standing Committee on the petition of Josiah Bradlee and others, relative to the Jamaica Pond Aqueduct, with report of Water Commissioners on same.
- 1847, Doc. 5, Second quarterly report of the Standing Committee on Water; Doc. 8, Report of Joint Standing Committee on petition of Silas P. Barnes; Doc. 19, Report on petition of Luther Mann and others; Doc. 27, Report of the Joint Standing Committee on; Doc. 28, An ordinance to regulate the proceedings of the Water Commissioners; Doc. 29, Report on a petition praying for the purchase of a part of Dorchester Heights, to be used for the purpose of a reservoir and public square; Doc. 30, Report of the Committee on Finance, on the progress made in negotiating a loan; Doc. 43, An order authorizing the Commissioners to

- purchase lands and water sites, erect dams, etc., for forming reservoirs to serve as a substitute for the water which may be diverted from Concord river; Doc. 44, Semi-annual report of Water Commissioners.
- 1848, Doc. 18, Report of consulting physicians on the action of Cochituate water upon mineral substances; Doc. 22, Report on petition that the water may be carried to East Boston; Doc. 32, Report of Commissioners on the best material for distribution water pipes, and the most economical mode of introducing water into private houses; Doc. 42, An ordinance in addition to an ordinance to regulate the proceedings of the Commissioners; Doc. 43, Report of the Committee on Water, and counter report concerning the schedule of water rents; Doc. 44, Report of the Committee on Water on the purchase of Jamaica Pond Aqueduct; Doc. 45, City Solicitor's opinion on the power of the Commissioners to establish the water rents; Doc. 50, Account of the celebration on the introduction of the water of Lake Cochituate.
- 1849, Doc. 3, Schedule of water rates established by the Water Commissioners; Doc. 4, Report of the Commissioners respecting the progress of the water works; Doc. 5, Report of Commissioners stating the number of hydrants provided for extinguishing fires; Doc. 18, Report of Commissioners on work to be done, and expenditures required; Doc. 24, Report on the expediency of carrying the water of Long Pond to East Boston; Doc. 26, An ordinance in addition to an ordinance to regulate the proceedings of the Commissioners; Doc. 29, Report on the act of the Legislature for supplying the city with water; Doc. 38, Report of Commissioners relative to reservoirs, etc.; Doc. 41, Engineer's report in relation to taking water to East Boston; Doc. 53, Report concerning charges for water supplied to fountains; Doc. 57, Report on a plan of organization of the water department; Doc. 61, Report of the number of persons, other than laborers, employed by the Commissioners; Doc. 63, An ordinance establishing the Cochituate Water Board; Doc. 68, Final report of the Commissioners.
- 1850, Doc. 3 $\frac{1}{2}$, Final report of Commissioners, N. Hale, J. F. Baldwin, and T. B. Curtis; Doc. 7, Quarterly report of the Water Board; Doc. 13, City Solicitor's opinion on the right to give water to the Children's Friend Society; Doc. 29, Tariff for 1851; Doc. 32 and 32 $\frac{1}{2}$, Ordinance providing for the care and management of the water works; Doc. 41, An ordinance in relation to water rates; Doc. 45, Annual report of the Cochituate Water Board; Doc. 51, Report upon examining the books and accounts of the Water Board.
- 1851, Doc. 37, Report of Water Board on an Aqueduct to Deer Island; Doc. 38, Communication from the Water Board respecting the purchase of the Boston Aqueduct; Doc. 40, Report of Commissioners on Water, concerning the power of the Water Board to purchase the franchise of the Jamaica Pond Aqueduct Co.; Doc. 46, Report from Water Board stating that they have purchased the property of the Aqueduct Corporation; Doc. 54, Report of Water Board on petition of R. Frothingham, Jr.
- 1852, Doc. 6, Annual report of Cochituate Water Board; Doc. 24, Report in relation to supplying the fountain in Louisburg square; Doc. 51, Report on the daily consumption of water; Doc. 67, Report on water loan.
- 1853, Doc. 7, Annual report of Water Board; Doc. 20, Reprint of annual report for 1851; Doc. 74, Reports and ordinance in relation to water rates.
- 1854, Doc. 11, An ordinance in relation to water rates; Doc. 16, Annual report; Doc. 19, An ordinance relating to the water works; Doc. 25, Report of Water Board on rates; Doc. 82, An ordinance to establish water rates; Doc. 111, An ordinance in relation to.
- 1855, Doc. 9, Annual report of Water Board; Doc. 30, Majority and minority reports

- of Committee on water works; Doc. 43, An ordinance in relation to; Doc. 48, An ordinance in relation to.
- 1856, Doc. 11, Annual report of Water Board,
- 1857, Doc. 12, Annual report of Water Board; Doc. 50, Report of Water Board on the subject of a new main pipe.
- 1858, Doc. 7, Annual report of Water Board; Doc. 16, An ordinance concerning the waste of water; Doc. 24, An ordinance to establish water rates; Doc. 57, Communication of the Water Board, relative to a supply for a skating pond; Doc. 60, An ordinance in relation to water rates.
- 1859, Doc. 8, Annual report of Water Board; Doc. 40, Communication from the Water Board, on the route of the new main pipe; Doc. 49, Report of the Water Board on the flowage of meadows on Sudbury river; Doc. 56, Communication from the Water Board, with an ordinance to revise the water rates.
- 1860, Doc. 13, Annual report of Water Board; Doc. 45, Report of the Water Board on laying the new main.
- 1861, Doc. 8, Annual report of the Water Board.
- 1862, Doc. 9, Annual report of the Water Board; Doc. 11, Report of the Water Registrar on the waste by hopper closets; Doc. 17, An ordinance providing for the care and management of the water works.
- 1863, Doc. 10, Annual report of the Water Board; Doc. 47, Report of the Committee on the reduction of the rates for the Massachusetts General Hospital.
- 1864, Doc. 20, Annual report of the Water Board; Doc. 68, Report on the petition to have water pipes laid in Lawrence street, said street being below grade; Doc. 76, Request of the Cochituate Water Board for a new reservoir.
- 1865, Doc. 20, Annual report of Water Board; Doc. 35, Report of Water Board on proposed amendment of rates; Doc. 57, Report on supply of water for fountains; Doc. 69, Report on rates for measured water; Doc. 76, Report on condition of works; Doc. 85, Report on estimates for new reservoir at Chestnut-Hill; Doc. 91, Report on purchase of Lawrence meadow; Doc. 92, Report and orders for construction of Chestnut-Hill reservoir; Doc. 102, Report on rates for dwelling-houses, etc.; Doc. 110, Amended ordinance increasing rates on dwellings, etc.
- 1866, Doc. 61, Annual report of Water Board; Doc. 64, An ordinance providing for the care and management of water works; Doc. 92, Plan of driveway around Chestnut-Hill reservoir.
- 1867, Doc. 88, Annual report of Water Board; Doc. 113, Request of Board for an additional appropriation for Chestnut-Hill reservoir.
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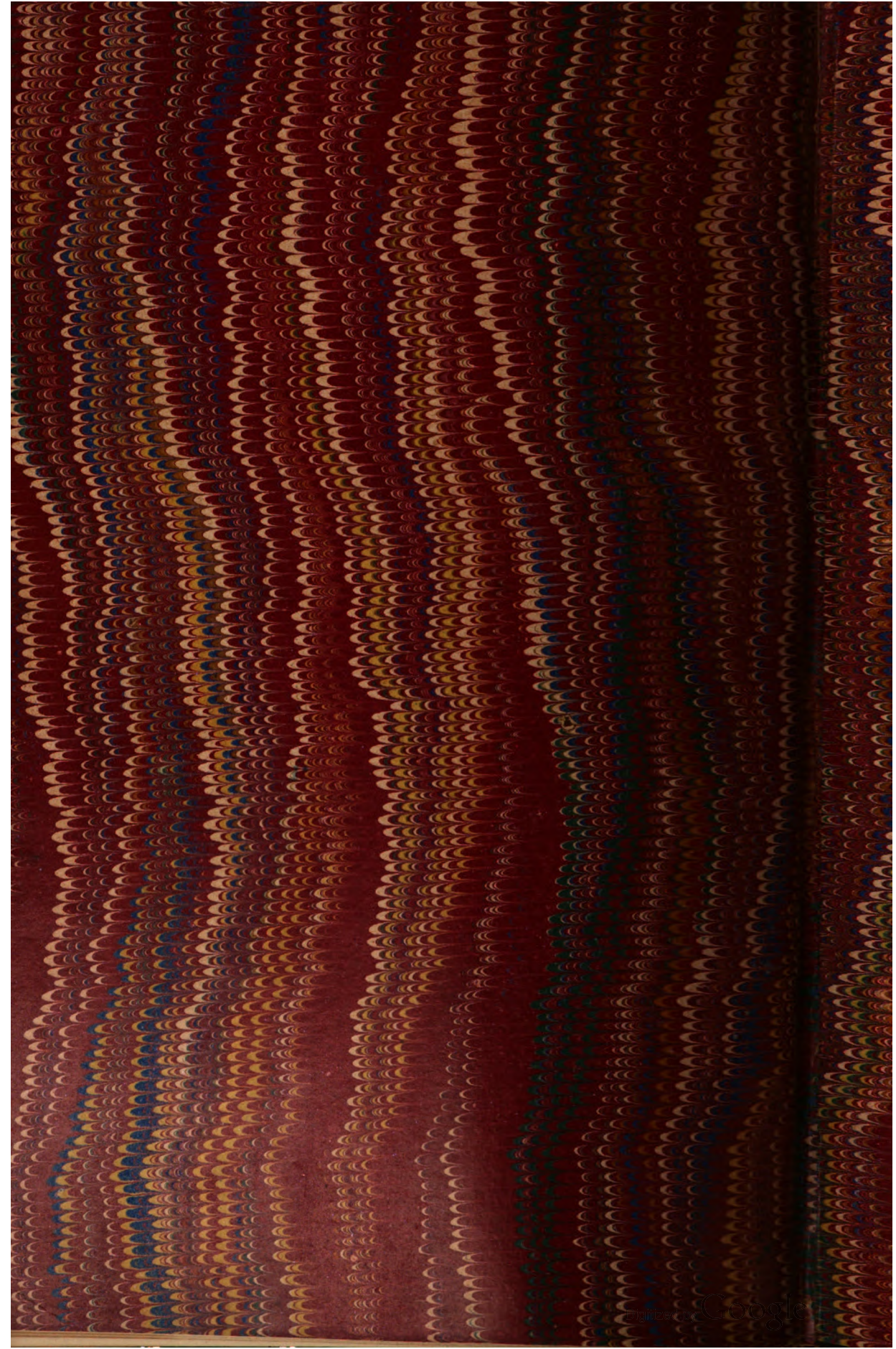
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